

POLICY

Predicting and Measuring Premises-Level Harm in the Night-Time Economy

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Abstract — **Aims:** To assess associations between measures of premises-level alcohol-related harm and risk factors for harm. **Methods:** Thirty-two licensed premises with a history of on-premises violent assault were recruited. An environmental survey of the drinking context of each premises was undertaken. Levels of patron intoxication were assessed using a breathalyser and a visual assessment of customers at each premises. Premise-level violence was identified via routine police and hospital emergency department data. Analyses examined associations between hospital and police data, surveyor and objective ratings of intoxication and the relationship between intoxication, drinking context and violence at the premises level. **Results:** Hospital and police data were associated. Aggregate levels of surveyor-rated intoxication were associated with aggregate alcometer breath alcohol levels. Analyses further suggest that premises with the highest levels of violence also had customers whose entry–exit change in intoxication was greatest, were open for longer hours, had alcohol promotions and had visible security staff present. **Conclusions:** Police and hospital data can be used to identify violent premises and to assess outcomes from premises-level interventions to reduce violence. Relatively low-cost observational survey methods can be used to identify high-risk premises, and can be used as outcomes for premises-level interventions. Features of premises that promote intoxication are associated with violence, suggesting that targeting resources at risky premises will likely address two public health concerns: excessive intoxication and assault-related injury.

INTRODUCTION

Late-night city centre environments that attract large numbers of young people are synonymous with violence and alcohol intoxication. Objective measures of intoxication in these settings suggest that drinkers substantially exceed even the more liberal definitions of moderate alcohol consumption (Lange and Voas, 2001; Moore *et al.*, 2007), and data from UK hospital emergency departments (ED) at peak times indicate that 40% of all attendees have a raised blood alcohol level, 14% are intoxicated and 43% are problematic drinkers (IAS, 2007). The regulation of premises in which alcohol is served and consumed provides one important point of intervention (AMS, 2004; Bellis *et al.*, 2006; Gilmore, 2001). However, tackling premises-level harm implies that those problems can be detected in the first place (Moore, 2006) and that the effectiveness of interventions can be appropriately evaluated. Determining the extent of alcohol misuse and assault-related injury associated with an on-trade premises is problematic. There are no routine measures of alcohol misuse and its precursors or reliable measures of the incidence and severity of violence at the premises level (Sivarajasingam *et al.*, 2003). There is therefore a need to assess the robustness of candidate measures of alcohol-related harm in the night-time economy (NTE), a need that this paper addresses.

Both police and ED data have advantages and disadvantages (Sivarajasingam *et al.*, 2003) with neither offering an unequivocal measure of assault-related injury associated with individual licensed premises. ED data are not universal, at least in the UK, but do record the more serious assaults that require hospital treatment. Police data will capture less serious incidents, a significant proportion of which will involve no physical harm, and these data will be skewed towards those premises routinely covered by police patrols. It is therefore feasible that those premises identified in ED data

may not appear in police data and vice versa. These potentially important biases are not critical so long as those premises identified as producing the most harm in police data are also those premises identified in ED data. In other words, for a given NTE, the rank order of premises in ED and police data need to agree so that resources are being appropriately targeted. This is the first hypothesis tested here.

Premises can also contribute towards levels of harm through encouraging or facilitating severe intoxication. While harmful in itself, excessive intoxication is further implicated in a range of risky behaviours including risky sex and injury. As with measuring violence, the question is then how best to characterize premises serving practices. One option that has become common is to employ confederates who attempt to purchase alcohol while feigning drunkenness (Lang *et al.*, 1998). There are several limitations in using pseudo-intoxicated confederates; first, they are not drunk and perceptive servers might assume their behaviour is due to other factors unrelated to excessive consumption; second, they are likely unknown to servers who may still serve familiar customers; third, it presents a hypothetical scenario to serving staff that does not capture the behaviour of all patrons. It is feasible that servers might serve a confederate alcohol, yet have very few severely intoxicated patrons on premises and, similarly, a confederate might be refused service due to being unfamiliar to servers, but the same premises might have regular customers who do drink excessively. A more objective approach would be to monitor patrons' blood alcohol levels as they enter and leave premises.

Breathalyser surveys provide a robust method of assessing alcohol misuse (Gill, 2002; Lange and Voas, 2001) but require considerable manpower, time and expense. One proxy to intoxication, adopted by law enforcement agencies across the world, is the field sobriety test (FST; Perham *et al.*, 2007). There are clear physical manifestations of

intoxication, which include glazed eyes, slurred speech and a staggering gait and these have been validated against alcometer data in social drinking environments (Perham *et al.*, 2007). These measures yield good inter-rater reliability (77% agreement for a staggering gait, 72% for glazed eyes and 71% for slurred speech), and scores are strongly associated with breath alcohol concentration (BrAC; Perham *et al.*, 2007). Thus, available measures of serving practice include BrAC, the FST and pseudo-intoxicated confederate refusals. An assumption in the use of the latter is that servers will be able to discern drunkenness and therefore refuse service (Goodsite *et al.*, 2008), and presumably those characteristics used by competent serving staff will include aspects of the FST (Goodsite *et al.*, 2008). If BrAC or FST data are available then this obviates the need for confederates and therefore the problems associated with their use. Observational measures do not require the cooperation of drinkers and can be collected with little overhead. However, these measures have not been assessed as a means to determine the extent of alcohol misuse attributable to licensed premises. In this respect, there are three measures of patron drunkenness of interest. First, the proportion of drinkers entering the premises who are intoxicated; the expectation is that premises staff should prohibit entry to those already intoxicated. Second, the extent of intoxication in those exiting premises, which would provide an indication of inappropriate serving practices, although premises that allow entrance to intoxicated patrons may also have patrons exiting the premises who are intoxicated irrespective of whether they were served or not. Finally, and most pertinent, is the difference between entrance and exit levels of intoxication. This would provide a direct measure of serving practices as the greater the differential the more likely irresponsible serving. We therefore sought to compare both BrAC and FST measures of intoxication, aggregated at the premises level.

Understanding premises-level risk factors for alcohol misuse and associated violence is also important in identifying intervention targets and content. Reflecting the complex multi-factorial nature of harm in the NTE, numerous measurable phenomena have been suggested as important in the aetiology of alcohol misuse and violence (Graham and Homel, 2008). In particular, the degradation of the local surroundings, for example, through accumulated litter, may portray a permissive environment (Keizer *et al.*, 2008) and send signals that disorderly behaviour is acceptable. Furthermore, congestion, crowding and competition for local resources including transport and food may potentially aggravate drinkers and further promote aggression (Moore *et al.*, 2008). Past research has explored the relationship between situational factors, intoxication and disorder in detail at the premises level (Graham *et al.*, 2006), but none have adequately described the relationship between objectively measured intoxication and aggression in licensed premises. A range of subjective measures have been employed, including observations of customers by trained researchers (Graham *et al.*, 2006), subjective ratings of premises 'atmosphere' ('Rowdy', 'Cosy' or 'High') by participants (Johnsson and Berglund, 2003) and surveyor ratings of drunkenness on a four-point scale ('No signs', 'Slightly drunk', 'Moderately drunk' and 'Extremely drunk'; Lang *et al.*, 1998). In the latter two studies, objective measures of intoxication (BrAC score) were also taken, but correlations between subjective and

objective measures were not reported. Building on the comparisons of measures of harm, we therefore sought to use objective measures to determine whether premises prone to the inappropriate sale of alcohol are also premises that exhibit high levels of violence, controlling for a range of risk factors, such as the price of alcohol, opening hours, alcohol promotions and measures of environmental degradation.

METHODS

The current study uses data from a larger project examining the feasibility of a randomized controlled trial of a premises-level intervention (Moore *et al.*, 2010). A component of this larger study was to research measures of harm in the NTE, the component that this paper addresses. The study is based in five UK towns: one large cosmopolitan city that attracts drinkers from across the UK, a large city with a traditional NTE and three smaller towns with well-defined NTE areas (two towns were in close vicinity and treated as one in later analyses). The inclusion criterion was that the premises had recorded a minimum of one police-recorded or ED-recorded violent incident in the 12 months up to premises recruitment. The aim was to recruit 32 premises (Moore *et al.*, 2010). Participation was voluntary and premises had the opportunity to withdraw from the study at any point. All premises ($n = 226$) in the study areas were initially sent a written invitation by letter; only three eligible premises responded. Eligible premises were, therefore, recruited with the collaboration of local police-led licensing services, a strategy that yielded a 100% participation rate. Thirty-two target premises were thus recruited that represented those premises that had the highest levels of disorder in each of the five recruitment areas and comprised standard public houses, high-volume vertical drinking establishments (typically a large bar with limited seating and no dance floor) and night clubs.

Measures

The current project accessed data from four sources: routine police data (one force covered all survey locations), local hospital ED attendance data, a breathalyser survey covering objective and visual assessments of drunkenness (Moore *et al.*, 2007; Perham *et al.*, 2007), and an environmental survey of premises activity that recorded characteristics of patrons as they entered and exited premises as well as door staff activity and features of the immediate environment, such as litter and crowding.

Police data

Anonymized data on recorded assaults for the period 1 March 2008 to 28 February 2009 were extracted from a police database. Through exploration of these data, it was possible to identify the location of recorded incidents. Any violence against a person that was associated with a study premises (i.e. inside or immediately outside the premises) was counted as a violent incident.

Emergency department data

Anonymized data on recorded attendance at an ED for an assault-related injury for the period 1 March 2008 to 28

February 2009 were extracted from health service records from two hospitals. These data included information about the location of the incident, such as the names of premises. ED data on assaults have been shown to be a reliable measure of community violence (Warburton and Shepherd, 2000). ED data were available for the full 12 months up to the start of the project for a subset of 14 premises and all 32 target premises for November and December 2008 and January 2009. This discrepancy was due to one ED not having systems in place to collate attendance data appropriately for nine months.

Data collection

Breathalyser survey

Premises were surveyed for 5 hours up until closing. The street survey methods replicated previous breathalyser surveys (Perham *et al.*, 2007). One team of two surveyors and one survey lead surveyed each premises for two consecutive weekend nights. Two premises were surveyed each night. Premises supervisors and local police were informed of survey plans in advance. Each surveyor was provided with one alcometer (Lions Labs SD400, calibrated to $\pm 3 \mu\text{g}$ alcohol/100 ml breath), a number of single use sterile alcometer tubes for use with the alcometer, one bottle of antibacterial hand gel to be used as required, lollipops to be given to respondents as a token of appreciation for their time, and one A4 survey sheet on which survey data were recorded. Surveyors were stationed as close to the target premises as possible but without impeding entrance to and exit from the premises. A pseudo-random sampling method was used, whereby an object, such as a lamp post, was chosen as a sampling landmark and every seventh person to walk past this landmark was asked if they would be willing to participate. Surveyors recorded non-response when prospective respondents refused to participate so that potential sampling biases could be investigated. For both responders and non-responders, surveyors recorded respondents' gender and rated them on the three binary descriptors used to identify drunkenness, whether they had a staggering gait, glazed eyes and slurred speech, and further estimated overall drunkenness along a 10-point Likert scale (Perham *et al.*, 2007).

Respondents who agreed to participate were initially briefed on the aims of the survey. They were informed that they were not obliged to answer every question in the survey, that identifiable information was not required, and that they were free to stop participating at any time (Aldridge and Charles, 2008). The respondent was questioned on their drinking locations (pre- and post-survey) and completed the fast alcohol screening test (FAST; Hodgson *et al.*, 2002). Respondents were breathalysed and the reading was recorded. Surveyors were instructed to not breathalyse those who were smoking (due to the potential for damaging the alcometer) or drinking alcohol (owing to the potential for alcohol in the mouth skewing results). Surveyors thanked the respondent for their participation and gave them a debrief form explaining the survey, the risks associated with alcohol misuse, issues of confidentiality, a brief explanation of BrAC readings, and their equivalent behavioural effects. Surveyors also wrote the respondent's BrAC score on this form. To ensure that intoxicated participants could later withdraw their consent, the debrief form also included information on how

to request deletion of their data from the study at a later date. Once the respondent had left the vicinity, the surveyor rated them according to staggering gait, glazed eyes, slurred speech and overall drunkenness.

Environment survey

Survey leads constantly surveyed patrons as they entered and exited each target premises, pausing briefly every 30 min to assess door staff activity and environmental degradation including the presence of litter and people loitering. They also noted incidents such as ejections, fights and arrests when they occurred.

Environmental degradation

Three measures recorded the quality of the environment: litter (whether litter was visible within 10 m of the premises), collapse (whether one or more drinkers were in a state of collapse within 10 m of the premises) and crowding (whether two or more drinkers were lingering, but not in an orderly queue, within 10 m of the premises entrance). Surveyors also recorded whether security staff were visible. Binary measures (whether the risk factor was present or absent) were averaged across the observation period to provide an index of exposure for each premises across both evenings of the survey.

Premises data

Researchers also collated data on the maximum capacity of each of the 32 premises (mean = 596, min 150, max 4200), the cheapest pint of alcoholic beer each serves outside of any promotions or loyalty schemes (mean price = £2.16, min = £1.20, max = £3.20, SD = 0.51), whether premises operated a promotion on weekends—of which 21 premises did—and the number of operating hours they were open after 11 p.m. on a Friday and Saturday.

One premises manager requested that customers not be breathalysed and, due to operational difficulties, exit BrAC was not recorded at two further premises. Street surveyors approached 1639 individuals, of whom 1351 completed the survey and 1274 agreed to be breathalysed; 1015 were breathalysed and intended to visit or had visited a target premises. Although surveyors were asked to survey only those entering and exiting the target premises, the sampling methodology meant 173 respondents were included who stated that the next intended premises and the past premises were the same. Of these 82% smoked and as smoking is prohibited in UK licensed premises these respondents were most likely temporarily leaving the target premises to smoke. Given the positive relationship between smoking and alcohol consumption (Moore and Foreman-Peck, 2009) and the likely bias introduced by these respondents, as their inclusion inflates the number of smokers in the sample, this subset of smokers was excluded from further analysis. Observations across 32 target premises resulted in 330 environment-level observations of the premises environment. Observations were made from 8.30 p.m. in the evening to 2.30 a.m. the following morning, on Fridays and Saturdays from April 2009 to October 2009 to coincide with the street surveys. The average number of people breathalysed per premises who stated that a target premises was where they had consumed their last drink was 21.25 and that for those who stated that

a target premises was where they intended to consume their next drink was 22.90. The average number of observations per premises in the Environment Survey was 10.31. For the breathalyser survey, the average FAST score was 5.99 (SD = 3.46), with 73% yielding scores greater than the threshold indicating at-risk drinking, highlighting the severity of drinking in the target NTEs.

Analytic strategy

The incident data are count data and so this suggests that models that accommodate counts are appropriate. Indeed, while ordinary least squares (OLS) is usually robust under varying conditions, count data are one of the few where OLS is likely to produce fallacious estimates. In the available data concerning violence, it is not possible to determine whether multiple incidents on the same day are related or not: it is feasible that a single episode involving violence can lead to multiple arrests and/or injuries. Furthermore, as the primary interest is premises-level risks, it is reasonable to assume that premises' failings persist across a session and therefore that multiple incidents in one session can be assumed as partly reflecting those risks. For violence, therefore, we assumed that one or more violent incidents indicated that for that session the premises was in a state of failure and was thus coded as a binary event. Furthermore, risks may be cyclical, particularly as premises are subject to high staff turnover rates and numerous external factors might influence premises-level failure rates, such as sporting events and temporary closure. While Poisson models can accommodate aggregate count data and would normally be suitable, to account for potential time-varying covariates, censoring, multiple events and discontinuous risk intervals, the preferred approach was to develop an Andersen–Gill model (Andersen and Gill, 1982), a derivation of the Cox proportional hazards model (Aalen *et al.*, 2008; Cook and Lawless, 2007). We report hazard ratios as these offer an easily interpretable statistic, such that if the hazard ratio is 2 for the presence of a particular binary covariate, for example drinks promotions, then we can say that the failure rate is double when that covariate is present. Considering the Nelson–Aalen cumulative hazards estimate for all premises over the full 12 months police data were available suggests that cyclical variation is not present (Fig. 1). Subsequent analyses are stratified by premises location (of which there were four, collapsing two NTEs that were in close proximity).

In conclusion, we sought to use objective measures to determine whether premises prone to the inappropriate sale of alcohol are also premises that exhibit high levels of violence. Furthermore, we consider how a range of risk factors, such as the price of alcohol, opening hours, alcohol promotions and measures of environmental degradation are associated with harm and associations between measures of harm.

RESULTS

Measures of violence

Police data logged a total of 310 assaults across all 32 premises in 12 months. Spearman's rank correlation yielded a robust association between total assaults across premises for

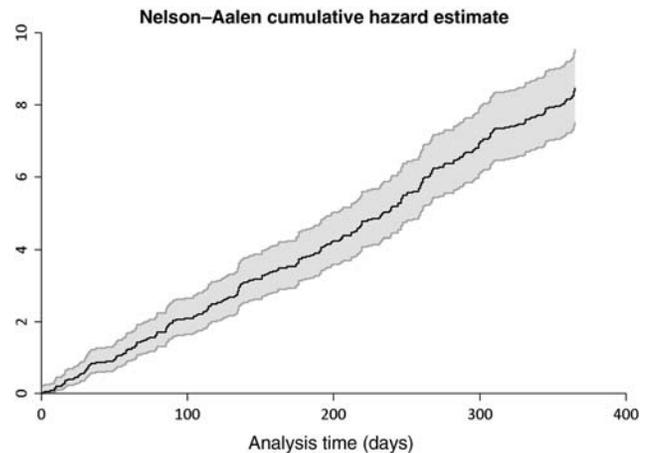


Fig. 1. Nelson–Aalen cumulative hazard estimate for the 365 days of police data, showing a linear hazard rate over time. The shaded area is the 95% confidence interval.

the 3 months both ED (total assaults = 21) and police data (total assault = 83) were available ($\rho = 0.50$, $P < 0.01$). A similar result was found for the 12-month period where 14 premises could be matched ($\rho = 0.67$, $P < 0.01$) in both ED and police data. Floor effects prevented the use of surveyor-recorded violence, with only 12 such events being recorded across all 32 premises. Larger premises by estimated capacity were associated with a greater number of police-recorded assaults ($\rho = 0.58$, $P < 0.001$). These data indicate that the rank order of premises is maintained across ED and police data.

Estimates of drunkenness

These analyses were conducted on all respondents irrespective of the premises they were visiting. Spearman's rank correlation on BrAC (mean = 50.48 μg alcohol/100 ml breath, SD = 28.88) yielded significant associations with surveyor ratings of drunkenness along the 10-point Likert scale (mean = 4.51, SD = 2.22) and the binary variables of having glazed eyes (44%), staggering gait (25%) and slurred speech (33%; $\rho > 0.40$, $P < 0.0001$) for each comparison; 1131 observations were available following case-wise deletion. Subjective drunkenness estimates on a 10-point Likert scale were also available for 257 people who refused to participate (mean = 3.68, SD = 2.50). A two-sample *t*-test correcting for unequal variance (Satterthwaite, 1946) yielded a robust effect indicating that non-respondents were more sober than respondents [$t(353.65) = 4.92$, $P < 0.001$], replicating a finding from an earlier study (Perham *et al.*, 2007). We interpret this effect as one where drinkers who are planning to drink more, and by implication more sober, are more interested in getting to their intended goal rather than spend time answering a survey. We argue that a staggering gait offers the most reasonable means of subjectively describing intoxication as it does not require close proximity to pedestrians and is not as susceptible as slurred speech or glazed eyes to environmental conditions such as noise and low light, respectively. Subsequent analyses therefore concentrated on this subjective measure, together with the overall measure of subjective drunkenness. Figure 2 presents a histogram of BrAC with proportions of drinkers staggering at each BrAC level.

Aggregate descriptors of intoxication across 29 premises are consistent with the above individual level analyses. To compute these analyses, we initially took the average patron score for each premises and subjected these to Spearman's rank correlation tests. The average premises BrAC correlates with the proportion of customers staggering ($\rho = 0.40$, $P < 0.05$), the proportion with slurred speech ($\rho = 0.43$, $P < 0.05$) and average levels of subjective drunkenness ($\rho = 0.41$, $P < 0.05$), suggesting that the production of severe intoxication due to premises' operation can be determined using observational data. We then calculated the same variables but restricted these to patrons entering a target premises and exiting a target premises. The average entrance BrAC correlates with the proportion of customers entering the premises who are staggering ($\rho = 0.45$, $P < 0.05$), and average levels of subjective drunkenness ($\rho = 0.53$, $P < 0.01$) and similarly the average exit BrAC correlates with the proportion of customers exiting the premises who are staggering ($\rho = 0.46$, $P < 0.05$), and average levels of subjective drunkenness ($\rho = 0.42$, $P < 0.05$). These analyses confirm that surveyors' subjective perceptions of drunkenness can be used as reliable measures of the extent that premises are either allowing intoxicated patrons on premises or the extent that premises are potentially serving those who are already intoxicated, with an increase between entrance and exit levels confirming the latter.

Drunkenness, violence and environmental risk factors

Table 1 presents summary statistics for the variables considered here. The first three models consider the relationship between aggregate measures of BrAC and violence independently. Entrance BrAC showed a modest association with violence [hazard ratio (HR): 1.00; 95% confidence interval (CI): 0.94, 1.00; $P = 0.07$], as did exit BrAC (HR: 1.04; 95% CI: 1.00, 1.08; $P = 0.06$), whereas change in BrAC, calculated by subtracting exit from entrance mean BrAC values for each premises, yielded a robust effect (HR: 1.06; 95% CI: 1.03, 1.09; $P < 0.001$). These analyses suggest that it is the change

in patrons' levels of intoxication that are most associated with premises-level violence and considering the change in intoxication measured by the proportion of staggering (multiplied by a factor of 10 for the purposes of these analyses; HR: 1.44; 95% CI: 1.32, 1.56; $P < 0.001$) and change in subjective drunkenness on the 10-point Likert scale (HR: 1.52; 95% CI: 1.34, 1.71; $P < 0.001$) yield similar results. For reasons outlined above, we regard a staggering gait as a more useful measure as these data can be collected more easily. In our first model, for premises-level violence, we therefore have a measure of patron intoxication (Table 2).

Our second set of models then considered premises' capacity, price of the cheapest pint of beer outside of promotions, hours open after 11 p.m. and the presence of alcohol promotions. Independently, capacity (divided by 1000 for the purposes of these analyses; HR: 1.51; 95% CI: 1.37, 1.65; $P < 0.001$), hours open past 11 p.m. (HR: 1.30; 95% CI: 1.24, 1.36; $P < 0.001$) and the presence of promotion (HR: 2.60; 95% CI: 1.89, 3.56; $P < 0.001$) predicted violence, whereas a higher price (HR: 0.75; 95% CI: 0.59, 0.95; $P < 0.05$) was associated with reduced levels of violence. However, in our sample, larger premises were more likely to stay open longer ($\rho = 0.81$, $P < 0.001$) and when these three regressors were combined into the same model, only promotions and hours open after 11 p.m. remained significant (Model 2, Table 2). The third set of variables considered concerned the premises' environment. Independent analyses suggest that evidence of drinkers in a state of collapse in the immediate vicinity of the premises (HR: 1.01, not significant) was not associated with violence, drinkers lingering outside the premises (HR: 0.66; 95% CI: 0.45, 0.97; $P < 0.05$) was associated with lower levels of violence, and both litter (HR: 1.36; 95% CI: 1.03, 1.80; $P < 0.05$) and the average number of visible security staff across the evening (HR: 1.70; 95% CI: 1.60, 1.82; $P < 0.001$) were associated with greater levels of violence. When combined, litter failed to reach significance, leaving security staff and lingering drinkers (Model 3, Table 2). When the significant regressors in Models 1 through 3 were combined, the

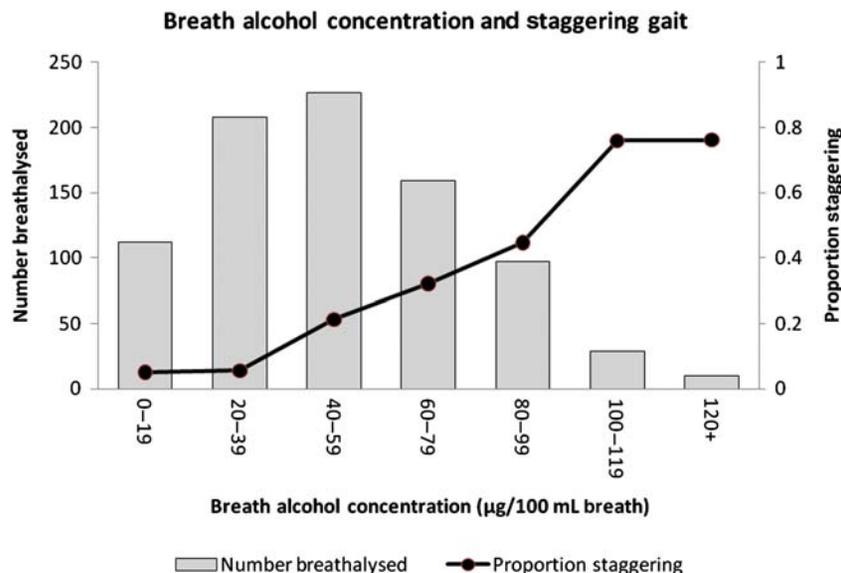


Fig. 2. The number of participants breathalysed by breath alcohol level and the proportion staggering in each category.

Table 1. Descriptive statistics

Measure	Mean (SD)
Entrance BrAC	50.15 µg/100 ml breath (13.77)
Exit BrAC	52.03 µg/100 ml breath (12.91)
Change in BrAC	2.82 µg/100 ml breath (16.55)
Entrance staggering gait ^a	0.18 (0.17)
Exit staggering gait ^a	0.28 (0.16)
Change in staggering gait ^b	0.13 (0.22)
Entrance subjective drunkenness ^c	4.11 (0.92)
Exit subjective drunkenness ^c	4.74 (1.29)
Change in subjective drunkenness ^c	0.79 (1.24)
Hours open past 11 p.m.	5.25 h (2.68)
Capacity	596.22 (758.79)
Price of the cheapest pint of beer	2.16 (0.51)
Alcohol promotions	0.66 (0.48)
Average number of visible door staff ^d	1.82 (1.15)
Patrons lingering outside the premises ^a	0.50 (0.32)
Litter present outside the premises ^a	0.36 (0.42)
Patrons in a state of collapse outside the premises ^a	0.06 (0.13)

^aIndividuals were scored on a binary scale and the average taken for each premises to produce a premises-specific index, the average of these indices across premises is presented.

^bChange was calculated for each premises by subtracting the entrance index from the exit index.

^cIndividuals were scored on a 10-point Likert scale and the average taken for each premises to produce a premises-specific index, the average of these indices across premises is presented.

^dThe number of visible door staff were counted every 30 min and the premises average taken as an index of door staff presence.

Table 2. Relationship between premises-level risk factors and violence

	HR	95% CI	P-value
Model 1 (change in drunkenness)			
Change in staggering gait	1.43	1.32, 1.56	<0.001
Model 2 (premises characteristics)			
Hours open beyond 11 p.m.	1.30	1.22, 1.36	<0.001
Alcohol promotions	2.78	2.02, 3.81	<0.001
Model 3 (premises environment)			
Lingering drinkers	0.46	0.31, 0.69	<0.001
Number of visible security staff	1.72	1.61, 1.85	<0.001
Model 4			
Change in staggering gait	1.33	1.21, 1.45	<0.001
Hours open beyond 11 p.m.	1.11	1.04, 1.20	<0.01
Alcohol promotions	2.10	1.43, 3.08	<0.001
Number of visible security staff	1.32	1.05, 1.67	<0.05

HR is the hazard ratio, CI is the 95% confidence interval and P is the significance level.

variable of lingering drinkers failed to reach significance and was dropped, resulting in Model 4 (Table 2).

DISCUSSION

Adequate measures of harm are a necessary pre-requisite to the evaluation of interventions that seek to reduce the levels of alcohol-related harm associated with the NTE. In this paper, we have considered the comparability of indices purporting to measuring violence and alcohol misuse. In the case of violence, we argue that ranking premises by levels of harm would be sufficient to identify those premises in which the incidence rate of violence was the greatest. Findings suggest a significant association in rank order between ED and police data. While each source is likely biased (police

data are collected only where officers are present or when the incident is reported and ED data collects information only on the more serious incidents), this result suggests such biases are evenly distributed across premises in such a way that rank order is maintained and that these measures are therefore both suitable to evaluate matched controlled studies. Counts from observational data were too low to warrant further analysis.

Tissue ethanol exposure increases the risk of alcohol-related disease (Rehm and Gmel, 2003) and is therefore the primary measure for interventions designed to reduce alcohol misuse. Alcometers provide a very close approximation of blood alcohol concentration (Gainsford *et al.*, 2006; Lindberg *et al.*, 2007) and therefore allow for objective measures in the NTE (Johnsson and Berglund, 2003; Lang *et al.*, 1998). While feasible, they require trained surveyors and impose considerable investments in manpower and time, suggesting that they do not provide practitioners with an optimum method to rapidly assess premises and evaluate interventions. UK legislation states that disorderly behaviour should not be permitted on the premises and those who become drunk on the premises should be prohibited from further service. Metrics of customer intoxication will, therefore, provide good evidence that premises are serving alcohol inappropriately. Our analyses suggest that subjective measures taken by trained surveyors are sufficient to identify the inappropriate service of alcohol.

Licensed premises that contribute most to levels of alcohol-related harm in a NTE environment can be identified using police data and surveyor ratings of intoxication. Aggregated at the premises level, premises that produce the highest proportions of severely intoxicated customers can be identified using observational measures facilitating opportunities to evaluate premises-level interventions to reduce intoxication. Premises that produce the most assault-related injuries are also those that produce the greatest proportion of severely intoxicated patrons, suggesting that underlying premises-specific risks may contribute to both forms of alcohol-related harm. While this suggests that failures in the operational characteristics of premises might contribute to both alcohol misuse and violence, it does not imply that those who are most intoxicated become violent. One interpretation is that severely intoxicated patrons tend to disrupt order in crowded areas and therefore elicit reactive aggression in other premises customers (Moore *et al.*, 2008).

Other factors including alcohol promotions, larger capacity, late-night opening and the presence of security staff were further associated with harm. However, the causal relationship between these measures and harm is not clear. Security staff, for example, are more likely in premises that already have problems and that therefore this does not imply that removing door staff will cause a reduction in violence. Large capacity and late-night opening were confounded in this study, with late-night opening most strongly associated with violence. However, not all premises are open late, and this might suggest that because some premises close early the number of drinkers seeking to continue their consumption cause overcrowding in late-night premises. Similarly, alcohol promotions are unlikely to promote violence by encouraging excessive consumption; the positive effect of promotions on violence remained in our model having controlled for intoxication. One interpretation is that those with

a tendency for excessive consumption are also more likely to be aggressive and that their need for alcohol makes premises offering cheaper drinks more attractive. The net effect is then one where promotions attract heavier drinking and more aggressive customers, in turn increasing the likelihood of conflict.

There are several limitations to this study. First, actively surveying customers from premises might change how premises' staff operate. While this is not so pressing when using police and ED data as indicators of violence, the collection of which is continuous and routine in the NTE, levels of intoxication may change. However, so long as any effect is uniform across the sample the rank order of premises in respect of intoxication would be preserved. Another limitation is the reasonably small sample size of target premises. This both limits generalizability and restricts inferences to only those most robust effects. Premises in this study included smaller establishments that closed in the late evening and large nightclubs that closed in the early morning. While we have included as many factors as possible to control for these differences, future studies may wish to stratify by premises type to explicate any reliable differences in risk factors according to these characteristics. Furthermore, this study was concerned with premises that had recorded instances of violence and were, by definition, risky premises. While uncovering premises-level risks of disorder are important, there may also be a case to appreciate risk together with protective factors. It may be the case that there are premises with no recorded violence and yet are still at risk. Revealing protective factors could offer a means of informing intervention content.

There is an urgent need for informed interventions targeting alcohol-related harm in the NTE and therefore reliable outcome measures. Future research should refine such measures of harm and begin rigorously assessing which risk factors contribute most to levels of harm. In the current study, risk measures were collected post hoc. A more robust prospective study, and one that also considers operational features relating to harm, is needed.

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