# Developing intelligence to understand and prevent violence and alcohol-related harms in nightlife settings

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# Contents

# Abstract

Violence and alcohol place huge burdens on public health, affecting individuals, wider society and public services. Many of the harms associated with violence and alcohol occur in nightlife settings and preventing these harms is a priority for the UK government. Increasingly, a public health approach to prevention is evident in both national and local policies and strategies. The use of data and evidence to understand the nature of the problem and to inform, target, monitor and evaluate preventive activities is fundamental to this approach. This thesis and supporting publications illustrate how my research has supported the public health approach to the prevention of violence and alcohol-related harms in nightlife and other settings.

Health data, such as emergency department (ED) attendance data, has a key role to play in the public health approach to prevention. The submitted articles illustrate how I have developed the use of ED data through establishing an injury surveillance system to inform prevention policies, strategies and practice at local and national levels. My analyses have been used to: identify the extent of alcohol-related harms; inform a nightlife management strategy; target prevention activity in nightlife areas where harms were more prevalent; and monitor trends in violence and alcohol-related harms over time. Further, my work has informed national policy; the collection of enhanced ED data on the circumstances of an assault is now being promoted by the UK Government.

Whilst routine data sources such as ED data can provide a vast array of intelligence on nightlife violence and alcohol-related harms they do not provide the level of detail necessary to illustrate patterns of alcohol consumption during a night out, individuals' experience of harms that do not come to the attention of authorities, or the wide range of risk and protective factors associated with these harms. Primary research is crucial to developing this knowledge. Thus, through studies conducted in England and cross-nationally, my research has identified that nightlife settings are the scenes of excessive alcohol consumption with preloading a common feature. Subsequently, many nightlife patrons enter nightlife areas already drunk. Over-serving of alcohol to drunks is common. A range of harms are experienced by nightlife patrons including verbal and physical aggression, sexual molestation and excessive

drunkenness. Both individual and environmental (i.e. venue) factors can increase the risks of nightlife patron involvement in alcohol-related harms.

In the UK, the prevention of harms in nightlife settings has primarily focused on developing safe nightlife environments. Few interventions have been developed that aim to tackle the culture of drunkenness, risky drinking behaviours (e.g. preloading) and the over service of alcohol to drunks that have been evidenced in my studies. With the links between alcohol and harms, such as violence, being well established, addressing the culture of drunkenness within nightlife settings has to be a key public health priority. Both primary research and analyses of routine data sources can support this approach by identifying at-risk communities where primary prevention interventions should best be targeted.

# Peer reviewed journal articles submitted for PhD

## Lead authored articles

1. **Quigg, Z**., Hughes, K., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Duch, M., Juan, M., Voorham, L. and Goossens, F.X. (2014). Incidents of harm in European drinking environments and relationships with venue and customer characteristics. *International Journal of Alcohol and Drugs Research*, 3, 269-275.

   *Impact Factor: NA*

2. **Quigg, Z**., Hughes, K. and Bellis, M.A. (2013). Student drinking patterns and blood alcohol concentration on commercially organised pub crawls in the UK. *Addictive Behaviors*, 38, 2924-2929.

   *Impact Factor: 2.02*

3. **Quigg, Z**., Hughes, K. and Bellis, M.A. (2012a). Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms. *Injury Prevention*, 18, 315-320.

   *Impact Factor: 1.94*

4. **Quigg, Z**., Hughes, K. and Bellis, M.A. (2012b). Effects of the 2010 World Cup football tournament on emergency department assault attendances in England. *European Journal of Public Health*, 23, 383-385.

   *Impact Factor: 2.52*

## Co-authored articles

5. Hughes, K., Bellis, M.A., Leckenby, N., **Quigg, Z**., Hardcastle, K., Sharples, O. and Llewellyn, D.J. (2014). Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal*

*of Epidemiology and Community Health* [online], 68, 453-456. Available at: http://jech.bmj.com/content/68/5/453.

*Impact Factor: 3.29*

6.  Bellis, M.A., Leckenby, N., Hughes, K., Wyke, S., **Quigg, Z**. and Luke, C. (2012b). Nighttime assaults: using a national emergency department monitoring system to predict occurrence, target prevention and plan services. *BMC Public Health* [online], 12, 746. Available at: http://www.biomedcentral.com/1471-2458/12/746.

*Impact Factor: 2.32*

7.  Hughes, K., **Quigg, Z**., Bellis, M.A., Calafat, A., van Hasselt, N., Košir, M., Voorham, L., Goossens, F., Duch, M. and Juan, M. (2012). Drunk and disorganised: relationships between bar characteristics and customer intoxication in European drinking environments. *International Journal of Environmental Research and Public Health,* 9, 4068-4082.

*Impact Factor: 1.99*

8.  Hughes, K., **Quigg, Z**., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Juan, M., Duch, M. and Voorham, L. (2011a). Drinking behaviours and blood alcohol concentration in four European drinking environments: a cross-sectional study. *BMC Public Health* [online], 11, 918. Available at: http://www.biomedcentral.com/1471-2458/11/918.

*Impact Factor: 2.32*

9.  Hughes, K., **Quigg, Z**., Eckley, L., Bellis, M.A., Jones, L., Calafat, A., Košir, M. and van Hasselt, N. (2011b). Environmental factors in drinking venues and alcohol-related harm: the evidence-base for European intervention. *Addiction*, 106 (S1), 37-46.

*Impact Factor: 4.75*

10. Bellis, M.A., Hughes, K., **Quigg, Z**., Morleo, M., Jarman, I. and Lisboa, P. (2010). Cross-sectional measures and modelled estimates of blood alcohol levels in UK

nightlife and their relationships with drinking behaviours and observed signs of inebriation. *Substance Abuse Treatment, Prevention and Policy* [online], 5, 5. Available at: http://www.substanceabusepolicy.com/content/5/1/5.

*Impact Factor: 1.45*

11. Hughes, K., **Anderson, Z**., Morleo, M., Bellis, M.A. (2008a). Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction*, 103(1), 60-65.

*Impact Factor: 4.75*

**Table 1: Contribution to submitted work**

| Article number (s) | Author status | Contribution to the article and study (s) (%), including short description |
|---|---|---|
| 1 | Lead | Contribution to the article: 60% / study: 40%<br><br>*Overall responsibility for article production; co-designed the article; co-designed data analyses and conducted all data analyses; and drafted/edited the article.*<br><br>*Co-designed, implemented and managed the full AMPHORA study in collaboration with Professor Karen Hughes, with statistical support from Professor Mark A Bellis, and local country implementation support from all other co-authors.* |
| 2 | Lead | Contribution to the article: 80% / study: 80%<br><br>*Overall responsibility for article production: co-designed the article; co-designed data analyses and conducted all data analyses; and drafted/edited the article.*<br><br>*Co-designed, implemented and managed the study with input from Professor Karen Hughes.* |
| 3, 4 | Lead | Contribution to the articles: 80% / studies: 80%<br><br>*Overall responsibility for production of articles: designed the articles; co-designed data analyses and conducted all data analyses; and drafted/edited the articles.*<br><br>*Co-designed, implemented and managed the studies with input from Professors Karen Hughes and Mark A Bellis.* |
| 5 | Co-author | Contribution to the article: 20% / study: 20%<br><br>*Contributed to study development and fieldwork coordination; trained field researchers; undertook field research; and edited the article.* |
| 6 | Co-author | Contribution to the article: 10% / study: 10%<br><br>*Advised on use of dataset and analyses; contributed to data preparation; advised on interpretation of findings; and edited the article.* |

| Article number (s) | Author status | Contribution to the article and study (s) (%), including short description |
| --- | --- | --- |
| 7, 8, 9 | Co-author | Contribution to the articles: 40% / studies: 40% <br><br> *Contributed to article design; assisted with data analyses and literature reviews; and contributed to article editing.* <br><br> *Co-designed, implemented and managed the full AMPHORA study in collaboration with Professor Karen Hughes, with statistical support from Professor Mark A Bellis, and local country implementation support from all other co-authors.* |
| 10 | Co-author | Contribution to the article: 25% / study: 30% <br><br> *Contributed to study design, data collection and analyses; conducted literature review; and contributed to article editing.* <br><br> *Co-designed, implemented and managed the study in collaboration with Professors Karen Hughes and Mark A Bellis.* |
| 11 | Co-author | Contribution to the article: 30% / study: 60% <br><br> *Contributed to study design, data collection and analyses; conducted literature review; and contributed to article editing.* <br><br> *Co-designed, implemented and managed the study in collaboration with Professor Karen Hughes.* |

## Supporting evidence - additional articles and reports

1. Wood, S., Ford, K., **Quigg, Z.** and Hughes, K. (2014a). *Violence profile: Wirral. Use of NHS data in local violence prevention.* Liverpool: Centre for Public Health, Liverpool John Moores University.

2. Wood, S., Ford, K., **Quigg, Z.** and Hughes, K. (2014b). *A guide to using health data to inform violence prevention.* Liverpool: Centre for Public Health, Liverpool John Moores University.

3. Ford, K., Wood, S., Hughes, K. and **Quigg, Z**. (2014). *Accident and emergency department data sharing to support violence prevention in Wirral*. Liverpool: Centre for Public Health, Liverpool John Moores University.

4. Hardcastle, K., Hughes, K. and **Quigg, Z.** (2014). *Perceptions and impact of the Shrewsbury Safer Nights minor injury unit*. Liverpool: Centre for Public Health, Liverpool John Moores University.

5. Hughes, K., **Quigg, Z**., Bellis, M.A., Calafat, A., van Hasselt, N. and Kosir, M. (2012) From home to pub. In: Anderson, P., Braddick, F., Reynolds, J. and Gual, A. (eds). *Alcohol Policy in Europe: Evidence from AMPHORA* [online]. Available at: http://amphoraproject.net/view.php?id_cont=45 [Accessed 29/7/14].

6. **Quigg, Z**., Rooney, J. and Perkins, C. (2012). *Violence-related ambulance call outs in the North West of England 2010/2011.* Liverpool: Centre for Public Health, Liverpool John Moores University.

7. **Quigg, Z.** and Brizell, J. (2012). *Injuries during the Winter*. Liverpool: Centre for Public Health, Liverpool John Moores University.

8. **Quigg, Z.**, Hughes, K. and Bellis, M.A. (2011). *Pub crawl: alcohol use amongst students attending organised drinking events.* Liverpool: Centre for Public Health, Liverpool John Moores University.

9. **Quigg, Z.** and Hughes, K. (2010). *Identifying environmental factors related to alcohol-related harm in European bars. Field researcher training manual.* Liverpool: Centre for Public Health, Liverpool John Moores University.

10. Schnitzer, S., Bellis, M.A., **Anderson, Z**., Hughes, K., Calafat, A., Juan, M. and Kokkevi, A. (2010). Nightlife violence – a gender specific view on risk factors for violence in nightlife settings; a cross sectional study in nine European countries. *Journal of Interpersonal Violence,* 25(6), 1094-1112.

11. Hughes, K., **Quigg, Z**., Bellis, M.A., Morleo, M., Jarman, I. and Lisboa, P. (2009). *Blood alcohol levels and drunkenness amongst people visiting nightlife in the North West*. Liverpool: Centre for Public Health, Liverpool John Moores University.

12. **Anderson, Z**., Whelan, G., Hughes, K. and Bellis, M.A. (2009*). Evaluation of the Lancashire polycarbonate glass pilot project.* Liverpool: Centre for Public Health, Liverpool John Moores University.

13. Morleo, M., Lightowlers, C., **Anderson, Z**., Cook, P.A., Harkins, C. and Bellis, M.A. (2009). A review of the impact of the Licensing Act on levels of violence in England and Wales: a public health perspective. *Crime Prevention and Community Safety* [online], 11, 204-218. Available at: http://www.palgrave-journals.com/cpcs/journal/v11/n3/full/cpcs200914a.html.

14. Stuart, J., **Anderson, Z**. and Hughes K. (2009). *Exploration of nightlife and associated problems in Prescot, Knowsley.* Liverpool: Centre for Public Health, Liverpool John Moores University.

15. Hughes, K., Bellis, M.A., Calafat, A., Juan, M., Schnitzer, S. and **Anderson, Z**. (2008). Predictors of violence in young tourists: a comparative study of British, German and Spanish holidaymakers. *European Journal of Public Health* [online], 18: 569-574. Available at: http://eurpub.oxfordjournals.org/content/18/6/569.long.

16. Bellis, M.A., Hughes, K., **Anderson, Z**., Tocque, K. and Hughes, S. (2008). Contribution of violence to health inequalities in hospital admissions for assault in England: demographics and trends in emergency hospital admissions for assault. *Journal of Epidemiology and Community Health* [online], 62, 1064-1071. Available at: http://jech.bmj.com/content/62/12/1064.full.pdf+html.

17. Hughes, K. and **Anderson, Z**. (2008). *Identifying drunkenness and preventing sales of alcohol to intoxicated customers in Manchester*. Liverpool: Centre for Public Health, Liverpool John Moores University.

18. **Anderson, Z**., Hughes, K. and Bellis, M.A. (2007) *Exploration of young people's experience and perceptions of violence in Liverpool's nightlife*. Liverpool: Centre for Public Health, Liverpool John Moores University.

19. Bellis, M.A., **Anderson, Z**. and Hughes, K. (2006). *Effects of the Alcohol Misuse Enforcement Campaigns and the Licensing Act 2003 on violence*. Liverpool: Centre for Public Health, Liverpool John Moores University.

# Acknowledgements

# 1. Introduction

Both in the UK and internationally, violence and alcohol are major public health priorities. Both place large burdens on individuals' health and well-being, as well as impacting on those around them, wider society and public services. Internationally alcohol consumption is a key risk factor for morbidity, disability and mortality, accounting for approximately 3.3 million deaths each year and 5.1% of the global burden of disease and injury (i.e. disability-adjusted life years) (World Health Organization, 2014a). Whilst per capita individuals aged above 15 years drink 6.2 litres of pure alcohol per year globally, there are wide variations in consumption, with developed countries recording much higher levels. The recorded UK average for 2008/09-2009/10 (pooled) was 11.6 litres of pure alcohol per capita (World Health Organization, 2014a). However, even within countries there are wide disparities in alcohol consumption between population groups and within different settings.

The World Health Organization defines violence as *"The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation"* (World Health Organization, 2014b, p5). This includes self-directed, collective and interpersonal violence, and covers a broad range of violence types such as youth, sexual and intimate partner violence, and child and elder abuse (World Health Organization, 2014b). Globally, interpersonal violence has been estimated to account for around half a million deaths per year (World Health Organization, 2014b). Levels of violence-related deaths vary widely by region, with the highest rates shown to be in low- to middle-income countries (World Health Organization, 2014b). However, even in high-income countries violence can be a major issue. In 2012/13 across England and Wales there were 551 recorded homicides (Flatley, 2014). For every death, thousands more incidents of non-fatal violence occur each year. In 2012/13, an estimated 1.9 million incidents of violence against adults occurred in England and Wales, around half of which resulted in injury (Flatley, 2014). Nearly half of all incidents of violence in England and Wales are not reported to the police (Flatley, 2014), yet victims may present at local health services as a result of their injuries. Across England an estimated 189,672 emergency department (ED) attendances (Upton et al., 2012), and over 35,000 hospital admissions (Bellis et al., 2012a), were caused by violence in 2010/11.

There are clear links between violence and alcohol consumption (World Health Organization, 2006), with half of all violence in England and Wales estimated to be alcohol-related (Flatley, 2014). Further, whilst violence occurs in many settings, just under a fifth occurs in or around pubs or nightclubs (Flatley, 2014). Nightlife settings are often the scenes of physical and verbal aggression, unintentional injury, and other risky behaviours and associated harms (Hughes et al., 2008a; Luke et al., 2002; Schnitzer et al., 2010). Excessive alcohol consumption and drunkenness now appears to be an accepted part of UK nightlife culture (Bellis et al., 2010; Bellis and Hughes, 2011). Thus preventing violence and alcohol-related harms in UK nightlife is a government priority, highlighted as a key area for prevention in the Government's Alcohol Strategy (HM Government, 2012) and violence prevention strategies (Bellis et al., 2012a; Home Office, 2008).

A public health approach to the prevention of violence and alcohol-related harms in nightlife settings is now evident in national policy, and in the development and implementation of interventions (Bellis et al., 2012a; Hadfield and Newton, 2010; Home Office, 2008). Such an approach is underpinned by the social ecological model that acknowledges that a broad range of often interrelating factors at the individual, relationship, community and societal level can influence a person's or group's level of risk of violence or alcohol-related harms (World Health Organization, 2014b). The public health approach has a number of key elements that includes the collection and use of data to understand the nature and extent of the problem, identify key risk and protective factors, and inform, develop, implement and evaluate prevention activity. Sharing information on effective practice, implementing such practice in different settings and determining their cost effectiveness is crucial to building the evidence base on what works to prevent violence and alcohol-related harms (World Health Organization, 2014b).

In the UK the primary data source used to inform the prevention of violence and alcohol-related harms in nightlife settings is police-recorded crime. Whilst such data provide a wealth of information on where and when harms occur, they only provide a snapshot understanding of such harms and their impacts. Often unexploited, health, particularly ED, data sources have great potential in identifying and understanding violence and alcohol-related harms. It has been estimated that one in three of all ED attendances have consumed alcohol immediately prior to their presentation, increasing to more than two in three between

midnight and 5am (Strategy Unit, 2003). Studies conducted in Wales and Denmark comparing local ED and police data have shown that between one third (Sutherland et al., 2002) and 80% (Faergemann et al., 2007) of violent incidents that resulted in ED attendance were reported to the police. Thus, in combination, police and health data sources can provide comprehensive intelligence on nightlife violence and alcohol-related harms, and a more realistic picture of the extent of such harms at a local level. However, such data sources provide little information on patterns of alcohol consumption during a night out, nightlife users' experiences of harms that do not come to the attention of the police or health service, or the different risk and protective factors associated with these harms. Conducting primary research with nightlife users is crucial to developing this knowledge.

This thesis, and supporting peer reviewed journal articles and research publications, illustrates how I have used original research to support the public health approach to the prevention of violence and alcohol-related harms, particularly in nightlife settings, at local, national and international levels. It is split into two distinct sections. The first section illustrates how I have developed and promoted the use of ED data in the prevention of violence and alcohol-related harms. It focuses on two peer reviewed journal articles that demonstrate how to set up and maintain an injury surveillance system using routine health data sources, and how data can be used to inform prevention policy and practice. The submission then focuses on a suite of nightlife research studies that explore alcohol consumption and related harms, including violence, in nightlife settings and identify key risk and protective factors. The thesis and supporting evidence aims to:

- Demonstrate how to establish an injury surveillance system to access, analyse and share routine health, particularly ED, data to inform local prevention;
- Illustrate the use of ED data in informing the prevention of violence and alcohol-related harms in nightlife, and other, settings;
- Explore the types of violence and alcohol-related harms experienced in nightlife settings, including key risk and protective factors for these harms;
- Understand drinking behaviours amongst nightlife participants and their links with associated harms; and,

- Demonstrate the value of using both secondary data sources and primary research to enhance knowledge around nightlife-related harms and to inform the development, implementation and evaluation of prevention activities.

The work summarised in this submission has been driven with support from local and national policy makers and practitioners, and colleagues from LJMU and elsewhere (e.g. European research networks). Through developing intelligence on violence and alcohol-related harms in nightlife settings the work presented has supported the development and implementation of both national and local policy and practice. For example, the collection of detailed data on the circumstances of assaults that lead to an ED attendance and the sharing of such data with local partners for prevention purposes is now mandated across England (Information Standards Board for Health and Social Care, 2014). Further, as a direct result of research findings, a number of local areas have implemented, and are continuing to implement, interventions in nightlife settings to reduce the service of alcohol to drunks, and associated harms (e.g. Liverpool [Quigg et al., 2015], South Wales [Quigg et al., 2015]).

All research has been undertaken, and all publications produced, whilst working at the Centre for Public Health (CPH), Liverpool John Moores University (LJMU).

# 2. Enhancing the use of ED data in the prevention of violence and alcohol-related harms

## 2.1 Background

ED data can provide rich information to inform local action to prevent violence and alcohol-related harms. At a national level, Government departments are supporting ED data sharing to inform local violence prevention activity (Cabinet Office, 2010; Teff, 2012). However, partners such as police, and even health and public health bodies, have struggled to access ED data (Boyle and Snelling, 2011; Centre for Public Innovation/Gecko Social Health Outcomes, 2012; Davidson et al., 2010). Obstacles to data sharing have included: variations in data collection methods and information systems between health providers; poor understanding of what can be shared while maintaining patient confidentiality; staff capacity issues; and a lack of incentives for health services to share data (Boyle and Snelling, 2011; Davidson et al., 2010).

## 2.2 Establishing a surveillance system to support prevention activity

**Submitted article**

**Quigg, Z**., Hughes, K. and Bellis, M.A. (2012a). Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms. *Injury Prevention*, 18, 315-320.

In 2001 the Trauma and Injury Intelligence Group (TIIG) was established in Merseyside. The multi-agency group (including representatives from health, police and academia) aimed to determine the extent of injuries among the population, identify at-risk groups and communities, and recommend evidenced-based interventions to prevent injury and support their implementation. However, a review of data sources indicated a lack of locally available data (Fell et al., 2002). Consequently, funding was secured to develop a population-based injury surveillance system (ISS). This enabled the employment of a researcher to set up, develop and manage the ISS, based at LJMU; the role for which I was recruited in 2004 and held until 2013.

With national and international focus on violence and alcohol as public health concerns (Bellis et al., 2012a; Home Office, 2008; HM Government, 2012; Krug et al., 2002; McVeigh et al., 2005; Strategy Unit, 2004; World Health Organization, 2014a), I established the ISS with a primary focus of collating, sharing and using health data sources in violence and alcohol prevention activity. Focusing on three main data sources (ED attendances, ambulance call outs and hospital admissions), I developed the ISS so that it systematically accesses, analyses and shares such information amongst partners to inform local action. At the same time it provides a valuable research resource that can support the development of policy and prevention strategies. The TIIG ISS is unique in England in that it follows a public health approach to informing local prevention activity (Krug et al., 2002). With no similar system in place, my article (Quigg et al., 2012a) brought together my experiences on developing the ISS, thus addressing a key gap in knowledge nationally. In particular, the article demonstrates: how to set up a routine ED data sharing system; what the data can show; and how data can be used towards the prevention of alcohol-related violence. The production of Quigg et al. (2012a) in part was to fulfil a growing need across England, and elsewhere, to understand how such data collection and sharing systems can be established and maintained successfully. I conceptualised the design of the manuscript and data analyses, conducted all data analyses and wrote the manuscript.

Using Wirral Local Authority Area as an example, Quigg et al. (2012a) details the methods I used in establishing, developing and maintaining the ISS. I held meetings with colleagues from the hospital trust and local partners involved in the prevention of violence, injury and alcohol-related harms. Discussions drew on existing research illustrating: the extent of and known risk factors for violence, injury and alcohol-related harms, and the impact on health and other services; health data availability and their potential use in prevention; data sharing legislation and patient confidentiality; and the implications of involvement in the ISS for ED practice. Data sharing protocols were established to ensure data were shared ethically (i.e. anonymised data sharing) and securely. I reviewed a sample of the ED dataset to identify fields most useful for prevention purposes, and thus inclusion in the ISS. Data shared covered all ED attendances entered onto their electronic patient administration system and included

fields from the national commissioning dataset (NCD)[1] (Connecting for Health, nd.) along with other injury-related data items already collected by the ED (including categories of injury types not recorded through the NCD). This subsequently led to more (i.e. 12,974 in 2009/10) injury attendances being identified that were otherwise recorded as a medical attendance in the NCD, and/or more detail on the injury type.

Quigg et al. (2012a) describes how I drove local data sharing by consulting with statutory and community organisations to identify local public health concerns and data needs, and subsequently liaised with health data providers to tailor data collection processes accordingly. This meant that ED systems were developed to systematically capture information on locally relevant issues, in particular alcohol-related injuries and violence occurring in nightlife settings. To do this, drawing on both research and practice (Warburton and Shepherd, 2004; World Health Organization, 2007), I liaised with the ED to expand data collection to include data from all injury patients on alcohol consumption (i.e. had the patient consumed alcohol in the three hours prior to injury), and from all assault patients, assault location details (e.g. street/pub name) and the number of attackers. For assault patients, extra data items were later added to include weapon use, and the time and date of the incident (Boyle et al., 2009). Quigg et al. (2012) shows how I promoted the use of ED data to develop, target and evaluate local prevention activity through: participating in relevant multi-agency meetings (e.g. nightlife management); producing reports based on partner concerns (e.g. injuries during the winter [Quigg and Brizell, 2012]); and offering bespoke data analyses to provide local partners with data necessary to inform individual prevention programmes. Further, I established bi-monthly meetings between ED staff and local partners where data collection, quality, analyses and use in prevention were discussed. Such meetings have been vital to ensuring staff receive feedback on their data collection and its importance in local prevention activity, subsequently maintaining high levels of data collection and quality.

In Quigg et al. (2012a) I demonstrated the utility of the TIIG ED dataset by analysing (using descriptive statistics, chi-squared and chi-squared for a trend) data from one ED collected over a six year period (2004/05-2009/10). This helped develop knowledge nationally on the

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[1] In England, a national commissioning dataset (NCD) has been established that requires all EDs to collect a standard set of data on each attendance, including injury group and location, patient demographics, attendance time and date, and arrival, referral and disposal method.

burden of alcohol and violence on EDs, with the small number of previous studies typically covering violence only (e.g. Sivarajasingham et al., 2008) or measuring alcohol across a sample of patients (Charalambous, 2002; Pirmohamed et al., 2000). My analyses found that 96.4% of all injury attendees were asked if they had consumed alcohol within three hours prior to their injury. Nearly half (47.2%) of intentional injury (e.g. assault, self-harm) and 4.9% of unintentional injury (e.g. sports injury) patients reported drinking alcohol (p<0.001). One-third (33.0%) of alcohol-related injury attendances were recorded as an assault, 27.9% a fall and 15.6% deliberate self-harm. Compared with non-alcohol-related attendances, alcohol-related attendees were more likely (p<0.001) to be male, aged 18-34 years, reside in the most deprived communities (using the Index of Multiple Deprivation 2007; a composite measure of deprivation combining economic, social and housing data [HM Government, 2010]) and attend the ED at night/weekends. Patients who reported having consumed alcohol prior to injury were more likely to be admitted to hospital than those who had not consumed alcohol (intentional injury: 37.5% cf. 19.7%, p<0.001; unintentional injury: 24.0% cf. 9.6%, p<0.001). Further, analyses of the ED data showed that intentional injuries accounted for 4% of all ED attendances, and 9% of all injury-related attendances. Compared with unintentional injury patients, intentional injury patients were more likely to be male, aged 18-34 years, live in the most deprived communities, have attended the ED at night/weekends, have been injured in a public place and have consumed alcohol prior to the injury. Routine analyses (shared with local partners) of the location of assaults leading to an ED attendance have identified licensed premises and locations in nightlife areas that are prone to violence, along with profiles of assault patients presenting at the ED.

Through illustrating the impact of alcohol and violence on EDs, and demonstrating the utility of ED data analyses in prevention, my research has informed a wide range of strategies and interventions. In Quigg et al. (2012a) I assessed the contribution of ED data sharing to local violence and alcohol-related harm prevention. Thus my analyses have been used to: inform strategies (e.g. Wirral evening and night-time strategy [Birkenhead and Wallasey Primary Care Trust, 2004]); set and monitor targets to evaluate progress (e.g. community safety partnership target to reduce alcohol-related ED assault attendances by 15% over a four-year period); identify problematic venues/locations for violence to target prevention initiatives (e.g. police and licensing enforcement); inform the types of interventions required (e.g. the use of safer drinking vessels [i.e. polycarbonate glasses] within licensed premises at peak times for violence); and develop referral pathways from the ED to relevant support services

(e.g. alcohol treatment services). The TIIG approach to collecting, analysing and sharing health data, and its use in prevention activity, has been viewed as best practice (Dellar and Pownall, 2007; Department of Health, Home Office, Department for Education and Skills, Department for Culture, Media and Sport, 2007; Home Office 2008), and is now promoted nationally by the Department of Health, Home Office and College of Emergency Medicine (Boyle et al., 2009; Teff, 2012). Subsequently, my research and knowledge has played a key role in developing the national agenda on the use of ED data in violence prevention, particularly that occurring in nightlife settings (see section 2.4: *Disseminating knowledge and sharing best practice*), and the international evidence base (Droste et al., 2014).

Quigg et al. (2012a) supports associations between health data sharing (and subsequent use in prevention activity) and reductions in violence, similar to that identified elsewhere (Florence et al., 2011). However, a key limitation of this paper is that is does not identify if data sharing is a critical component in the multi-agency response to tackling violence and alcohol-related harms or symbolic of strong multi-agency responses being in place. With ED data sharing now being promoted, initiated and implemented throughout England, the current heterogeneity of approaches is likely to provide sufficient variation for a broad ecological analysis of factors associated with reductions in violence. Thus, in 2011, I was a co-applicant on a Department of Health research grant successfully secured by CPH to identify and support the optimum use of NHS data in local violence prevention, and to identify the impacts of local NHS data sharing practices on levels of violence (see section 2.4: *Disseminating knowledge and sharing best practice*). Elsewhere, a prospective approach to identifying any causal relationships between data sharing and violence prevention could use a study design where similar areas without data sharing are matched, and data sharing is deliberately introduced into one set of cases for comparison with control areas. Such studies would need to take into account a variety of factors including socio-demographics, alcohol outlets density, level of multi-agency cooperation and local prevention activity.

## 2.3 Enhancing the use of health data in violence prevention research

**Submitted article**

**Quigg, Z**., Hughes, K. and Bellis, M.A. (2012b). Effects of the 2010 World Cup football tournament on emergency department assault attendances in England. *European Journal of Public Health*, 23, 383-385.

**Supporting evidence**

Bellis, M.A., **Anderson, Z**. and Hughes, K. (2006). *Effects of the Alcohol Misuse Enforcement Campaigns and the Licensing Act 2003 on violence*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Morleo, M., Lightowlers, C., **Anderson, Z**., Cook, P.A., Harkins, C. and Bellis, M.A. (2009). A review of the impact of the Licensing Act on levels of violence in England and Wales: a public health perspective. *Crime Prevention and Community Safety* [online], 11, 204-218

Following the success of the TIIG ISS in Merseyside, I led the roll out of the system across the North West of England. This has allowed me to develop research and intelligence using the ISS to inform prevention activity across a much wider population and to meet both local and national needs. For example, in Quigg et al. (2012b) I co-designed and conducted a study analysing assault data from 15 EDs to explore the impact of the televised 2010 FIFA World Cup football tournament[2] on levels of violence. The study aimed to inform a national debate regarding the potential impact of major sporting events on levels of violence and alcohol consumption in nightlife settings, and subsequent pressures placed on local services. Data on ED assault attendances at particular time periods (pre, during and post-World Cup, and similar time periods in the preceding three years) were extracted and analysed using descriptive statistics and a generalised linear model (GLM). The GLM was used to independently examine the effects of the event on levels of ED assault attendance. Here, counts of assaults per day were square root transformed to ensure they approximated to a normal distribution (one sample Kolmogorov-Smirnov test for normality, p=0.339). Results showed that the majority of assault attendances during the World Cup period were male and aged 18-34 years. On the days that England played (four matches) ED assault attendances

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[2] An event held in South Africa and televised across the World.

increased by 37.5%. Other factors independently associated with attendances were day of the week (assaults were higher on Fridays, Saturdays and Sundays; $p<0.001$), period (pre and during-World Cup periods were higher than the post period; $p<0.05$) and year (attendances decreased each year; $p<0.001$).

Understanding the effects of events such as the FIFA World Cup on violence is critical in planning local and national responses for future events including health staffing requirements, service provision, policing responses and prevention activity. Quigg et al. (2012b) contributes to this knowledge and has been used to increase understanding around the impact of major sporting events, particularly the 2014 FIFA World Cup (Alcohol Concern, 2014) and the 2012 Olympics held in London (Morleo et al., 2013). It provides empirical evidence to support the need for prevention measures during major sporting events and shows that ED data have the potential to identify violence associated with such events and thus inform both the targeting of prevention efforts and assessments of their effectiveness. However, the study does have some limitations. England were only involved in four matches during the tournament, and the impact of the World Cup may have been different had England progressed to the final. Equally, our analysis focused on EDs in the North West of England and therefore may not be representative of England. Further, during the event, expected increases in violence and alcohol consumption in England led to the implementation of a range of prevention initiatives including awareness campaigns (e.g. domestic violence) and increased police enforcement activity. Our study could not control for any impacts of these interventions on ED assault attendances. In Bellis et al. (2006) for example, where I assisted with data extraction, analyses and report writing, our analyses of ED data indicated that assault attendances decreased when the Alcohol Misuse Enforcement Campaign (AMEC)[3] was in place, and after the Licensing Act 2003 was introduced (other studies looking at the impact of the Act have shown varying results; Hough and Hunter, 2008; Morleo et al., 2013; Newton et al., 2007).

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[3] The AMEC was a national campaign that aimed to reduce and prevent a range of alcohol-related harms such as underage drinking and alcohol-related violence.

**Submitted articles**

Bellis, M.A., Leckenby, N., Hughes, K., Wyke, S., **Quigg, Z**. and Luke, C. (2012b). Nighttime assaults: using a national emergency department monitoring system to predict occurrence, target prevention and plan services. *BMC Public Health* [online], 12, 746.

**Supporting article**

Bellis, M.A., Hughes, K., **Anderson, Z**., Tocque, K. and Hughes, S. (2008). Contribution of violence to health inequalities in hospital admissions for assault in England: demographics and trends in emergency hospital admissions for assault. *Journal of Epidemiology and Community Health* [online], 62, 1064-1071.

The impact of events was further explored in Bellis et al. (2012b). Here, we used national (experimental[4]) ED attendance data to identify changes in service pressures for night-time assaults with calendar, celebration and sporting events. The national ED attendance dataset is a relatively new dataset, providing basic details of presentations at EDs, including major (Type 1) EDs, single speciality EDs, walk-in centres and minor injury units. Due to my expertise in ED data analysis, my role included: advising on the use of ED data and appropriate analyses; carrying out data extraction, formatting and quality assurance; assisting in the interpretation of study findings; and manuscript editing. Using a GLM, analyses found assault attendances peaked: on Fridays and Saturdays; the eves of bank holiday (with the greatest peak on New Year's Eves); during the summer (peaking in August); during some celebrations without a public holiday (i.e. Halloween, Guy Fawkes and St Patrick's nights); and during home nation World Cup matches (as shown in Quigg et al. [2012b]). Assaults fell during the 2008 London Olympics (another televised event).

Bellis et al. (2012b) also sought to identify individual and community risk factors for night-time assaults. Analyses found that males and those living in the most deprived areas (based on IMD 2010) were at greatest risk of assault presentation, and across all ages a peak in risk was seen at age 18. Differences in female presentations were observed across deprivation groups. Whilst female presentation in the least deprived areas peaked at age 20, by age 13 females in deprived communities exceeded this peak. The relationship between health

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[4] The national ED attendance dataset is a relatively new dataset that has a range of data quality and quantity issues (HES Data Quality Team, 2014).

inequalities and violence identified in Bellis et al. (2012b) is supported in previous research using hospital admissions for violence. In Bellis et al. (2008), where I assisted with the literature review and manuscript editing, data show that higher rates of admission for violence were associated with deprivation across the majority of age groups. Using logistic regression, analyses show that males were nearly six times more likely to be admitted to hospital for an assault, with such admissions peaking in those aged 15-29 years.

Findings from Quigg et al. (2012b) and Bellis et al. (2012b) illustrate the pressures events place on health services that are pertinent to all front line services (e.g. ambulance, police). Such information can help formulate responses to events. Findings from these papers, along with Bellis et al. (2008) and Quigg et al. (2012a), illustrate the wider benefits of using health data to inform prevention that goes beyond the national focus of ED data sharing. That is, the collection and sharing of enhanced data on assault circumstances, particularly assault location, to inform prevention, primarily targeted policing and licensing enforcement. Whilst Quigg et al. (2012a) and other recent studies across England and Wales show the benefits of this (i.e. reductions in violence; Boyle and Snelling, 2011; Florence et al., 2011), my studies argue that ED data sharing should go further and include information on patient demographics and area of residence. While targeting police resources in nightlife environments can reduce violence occurring in such locations, the tendencies that lead to violence in young adults are likely established far earlier in life. Thus, health data on assault patients' area of residence should be used alongside that of the location of assault to implement broader violence prevention strategies, particularly primary prevention (e.g. parenting programmes).

## 2.4 Disseminating knowledge and sharing best practice

**Supporting reports**

**Quigg, Z**., Rooney, J. and Perkins, C. (2012). *Violence-related ambulance call outs in the North West of England 2010/2011*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Wood, S., Ford, K., **Quigg, Z.** and Hughes, K. (2014a). *Violence profile: Wirral use of NHS data in local violence prevention*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Wood, S., Ford, K., **Quigg, Z.** and Hughes, K. (2014b). *A guide to using health data to inform violence prevention*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Ford, K., Wood, S., Hughes, K. and **Quigg, Z**. (2014). *Accident and emergency department data sharing to support violence prevention in Wirral*. Liverpool: Centre for Public Health, Liverpool John Moores University.

The use of health data in the prevention of violence and alcohol-related harms has developed in recent years and my work has contributed to this development. I have supported both local and national partners in implementing health data sharing, informing policy, strategic plans and interventions. Locally, I have been a member of, and chaired, a range of multi-agency steering groups tasked with preventing violence and alcohol-related harms (e.g. Greater Manchester Alcohol and Violence Community Safety Sub-group) and developing local data sharing. Further, I have organised and supported the development of numerous conferences across the North West to promote and develop ED data sharing and use at a local level, and share best practice, particularly in relation to preventing violence and alcohol-related harms in nightlife settings. On behalf of Government Office North West[5] I have acted as the North

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[5] Government Offices for the English Regions were set up in 1994 to deliver UK government policies and programmes at a local level. Each office represented a number of government departments, and was involved in a range of issues including tackling crime, community

West lead for ED data sharing. This included: providing support to regional and national partners on developing local data sharing systems; sharing best practice; and obtaining national funding to further develop the TIIG ISS across the North West. My work has been recognised as a model of good practice in supporting the prevention of violence and alcohol-related harms particularly in nightlife settings (Dellar and Pownall, 2007; Department of Health, Home Office, Department for Education and Skills, Department for Culture, Media and Sport, 2007; Home Office 2008). As part of national campaigns (e.g. Tackling Knives and Serious Youth Violence Programme) aimed at preventing violence and alcohol-related harms in nightlife settings, I have been consulted on developing health data sharing for prevention purposes, including presenting at national conferences and workshops. Further, I have been asked to contribute to and, or peer-review government documents on the use of ED data in violence prevention (Davison et al., 2010; Teff, 2012).

Enhanced ED data collection and sharing to support violence prevention is a Government priority and is highlighted in *The Coalition: our programme for Government* (Cabinet Office, 2010). The programme states that "*we will make hospitals share non-confidential information with the police so they know where gun and knife crime is happening and can target stop-and-search in gun and knife crime hot spots*". To support this commitment, in November 2010 a cross government department Information Sharing Implementation Group was established, of which I was a member. Through this role I have contributed to a national work programme to develop the use of enhanced ED and other health (e.g. ambulance call out [Quigg et al., 2012b) data in violence prevention. The work of this group has led to the production of a wide range outputs to develop ED data sharing including amendments to existing policy, the development of an NHS information standard and the production of guidance documents (e.g. Teff, 2012).

Further, in 2012 the Department of Health funded CPH, LJMU, to conduct a research study to identify and illustrate the optimum use of health data in violence prevention across England, of which I am a co-applicant. Through this project, we have produced a range of outputs to support local and national partners in developing ED data sharing, and using health data for prevention purposes, including: case studies of local ED data sharing (Ford et al.,

regeneration and improving public health. The offices were abolished in 2011 as part of the Coalition Government's 2010 Spending Review.

2014); profiles of local violence using health and police data (Wood et al., 2014a); and a guide to using health data for prevention purposes (Wood et al., 2014b). Through this project I am supporting the Department of Health, Public Health England and NHS England in delivering the Coalition's commitment to ED data sharing, ensuring our outputs support the national work programme.

# 3. Research conducted in nightlife settings

**Supporting evidence**

**Anderson, Z**., Hughes, K. and Bellis, M.A. (2007) *Exploration of young peoples' experience and perceptions of violence in Liverpool's nightlife*. Liverpool: Centre for Public Health, Liverpool John Moores University.

**Anderson, Z.**, Whelan, G., Hughes, K. and Bellis, M.A. (2009*). Evaluation of the Lancashire polycarbonate glass pilot project.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Hardcastle, K., Hughes, K. and **Quigg, Z**. (2014*). Perceptions and impact of the Shrewsbury Safer Nights minor injury unit*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Hughes, K. and **Anderson, Z**. (2008). *Identifying drunkenness and preventing sales of alcohol to intoxicated customers in Manchester.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Stuart, J., **Anderson, Z.** and Hughes, K. (2009). *Exploration of nightlife and associated problems in Prescot, Knowsley.* Liverpool: Centre for Public Health, Liverpool John Moores University.

## 3.1 Background

Nightlife settings are known to be common locations for violence and alcohol-related harms, most often evidenced through national surveys (e.g. Crime Survey for England and Wales [Flatley, 2014]) and routine data sources (e.g. police-recorded crime). Whilst these data sources can provide an overview of such harms, they only show part of the problem. As shown in the previous chapter, local ED data can enhance this picture, providing intelligence that may not have otherwise been known and also identifying issues that may require further research. For example, at a local level my analyses of ED data have contributed to identifying

particular pubs, bars and nightclubs as key locations for violence amongst young people, which were unknown to local police. These findings have informed the need and development of two separate primary research studies (Anderson et al., 2007 / Hughes et al., 2008a; Stuart et al., 2009). Further, the identification of glass-related injuries amongst ED presentations led to the piloting and evaluation of the use of polycarbonate glasses in licensed premises in Lancashire (Anderson et al., 2009). Such studies have provided a wealth of information on nightlife-related harms, risk and protective factors, and the impact of prevention activity, that could not have been obtained from analyses of routine data sources alone.

Further, findings from Anderson et al. (2007) and Hughes et al. (2008a) have informed the development of further nightlife research. Anderson et al. (2007) presents the first of a stream of nightlife research projects that I have managed or contributed to, conducted in collaboration with Professor Karen Hughes. Until recently, research on violence and alcohol-related harms in nightlife across the UK, and more broadly Europe, has been rare. Working with both UK and European colleagues, my research has helped develop knowledge of nightlife harms to inform prevention. This section details my role in developing and delivering a selection of this research, how it has influenced further research, and the importance of the research for prevention and policy.

## 3.2 Implementing nightlife research

During my nightlife research studies I have used a variety of methods including: surveys and breathalyser tests with nightlife patrons; surveys and face-to-face interviews with nightlife workers (e.g. licensees, bar and door staff, police); unobtrusive observations in nightlife venues; and analyses of secondary data sources (e.g. police-recorded crime data). I have been involved in a wide range of studies in England and across Europe, all of which have provided me with a breadth of experience and knowledge in conducting nightlife research. Whilst nightlife environments provide an opportune location to access those using and managing nightlife settings, conducting research in such settings presents a range of practical and ethical challenges. Typically nightlife patrons are on a night out for recreational purposes, consuming alcohol (and potentially other illicit drugs) in dark, noisy and busy environments. These issues need to be considered and addressed when designing and implementing research in nightlife settings.

Thus, to ensure my studies were conducted safely, ethically and rigorously, I have: produced detailed research protocols; obtained ethical approval from appropriate bodies; and conducted risk assessments identifying and addressing potential harms to both researchers and participants (Bellis et al., 2010; Hardcastle et al., 2014; Hughes and Anderson, 2008; Hughes et al., 2008a; Hughes et al., 2014; Quigg et al., 2013; Quigg et al., 2014). Measures put in place to maintain field researcher safety have included: developing a researcher information pack containing work schedules (so all researchers are aware of where they are working, when and who with), researcher mobile telephone numbers, contact details for key individuals (such as the lead police officer on duty), and locations for safe meeting/rest points. Additional measures put in place have included ensuring: only trained researchers (see below) conducted the study; researchers work in teams of at least three people (maintaining close proximity to each other with access to a mobile telephone); research teams comprised of mixed gender groups (i.e. during observational research to discourage unnecessary personal interaction with nightlife patrons [Quigg et al., 2014]); police are informed of researchers' presence in the nightlife environment; and all researchers got home safely (i.e. via taxi, own/another person's transport), informing the research supervisor by text message upon their safe arrival home.

Measures implemented to promote participant safety have included ensuring: research participation did not lead to participants being left on their own; researchers wore a visible identification badge (e.g. LJMU staff pass); and research was conducted in well-lit spaces. In addition, to meet ethical requirements relating to informed consent, for my studies field researchers were instructed to visually assess potential participants for signs of severe inebriation (e.g. staggered gait and glazed eyes; measures used by the police and in other research studies [Perham et al., 2007]) and exclude those who were already too intoxicated to participate (Aldridge and Charles, 2008). For all my studies I have produced detailed participant information sheets for potential participants detailing the purpose of the study, what they are being asked to do, along with contact details should they require further information. These details were also provided to them verbally prior to their participation.

Prior to implementing each of my nightlife research studies, I developed and delivered training sessions for field researchers covering: safety issues; ethics and informed consent; study aims and methods; participant recruitment; data collection tools; and accurate data

collection (Bellis et al., 2010; Hughes et al., 2008a; Hughes et al., 2014; Quigg et al., 2013; Quigg et al., 2014). My training sessions included a mock/pilot data collection session conducted within the nightlife setting. This allowed field researchers an opportunity to practice collecting the data and raise any concerns, and myself to assess the quantity and quality of their data collection, prior to the full study being implemented.

As a direct result of my practical nightlife research experience and management of local nightlife research projects/researchers, I have jointly managed (alongside Professor Karen Hughes) the implementation of a European wide nightlife research study (part of the Alcohol Measures for Public Health Research Alliance [AMPHORA] project) (Hughes et al., 2011a; Hughes et al., 2011b; Hughes et al., 2012; Quigg et al., 2014). Through my network of European colleagues developed from other nightlife studies (Hughes et al., 2008a; Schnitzer et al., 2010), a key part of my role within the AMPHORA project was to develop (including the provision of training materials; e.g. observational research training manual [Quigg and Hughes, 2010]) and implement field research training for country leads, who would then subsequently train their field research teams.

My experience in European nightlife research has enabled me to examine the suitability of nightlife research tools used outside Europe for use in Europe (i.e. nightlife observational research schedules; Canada [Graham et al., 2004] and Australia [Homel et al., 1997]). My assessment showed that their level of suitability could be influenced by language, structural and cultural issues. I then sought to implement strategies to reduce any such impact on the research. Thus the field research schedules, surveys and training materials used in our AMPHORA study were reviewed by myself and multiple European partners, and, where relevant, altered to suit local language, terminology (e.g. the inclusion of botéllon[6] in the Spanish surveys as a measure of preloading; Hughes et al. [2011b]) and nightlife settings. Differences between countries in what constitutes harm in nightlife and levels of intoxication was a key issue in AMPHORA. Thus in the training package, I included detailed definitions on different levels of intoxication and explicit lists on the wide range of harms that they may witness (e.g. someone vomiting, falling over or being assaulted). A mock bar observation was also conducted to ensure researchers were recording data items accurately and consistently.

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[6] I.e. groups of people drinking alcohol and socialising in public places.

Further, our multi-country alcohol surveys were designed to enable the comparison of alcohol consumption across countries with varying drink sizes and alcohol strengths.

## 3.3 England research findings

**Submitted article**

Hughes, K., **Anderson, Z**., Morleo, M., Bellis, M.A. (2008a). Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction*, 103(1), 60-65.

**Supporting evidence**

**Anderson, Z**., Hughes, K. and Bellis, M.A. (2007) *Exploration of young peoples' experience and perceptions of violence in Liverpool's nightlife*. Liverpool: Centre for Public Health, Liverpool John Moores University.

In Hughes et al. (2008a) and Anderson et al. (2007) we explored young peoples' experiences and perceptions of violence and other harms in a city's nightlife area. We implemented a cross sectional survey amongst 380 young people (aged 18-35 years) in 18 randomly selected bars, pubs and nightclubs. The survey explored: participants' demographics; frequency of utilising nightlife; quantities of alcohol consumed prior to and during a typical night out; and negative experiences (e.g. fighting) in the city's nightlife in the previous year. I designed and planned the study with guidance from my research manager, trained field researchers, managed and carried out data collection, designed the study database and entered the data, designed and conducted data analyses, and produced a detailed research report exploring young peoples' perceptions and experiences of nightlife violence (Anderson et al., 2007). Further, I assisted (i.e. supporting literature searches, data analyses and manuscript editing) in the production of a peer reviewed journal article exploring the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes (Hughes et al., 2008a). The study was funded by Government Office North West to help develop understanding of violence and alcohol-related harms occurring in nightlife settings.

Our analyses found that 11% of participants had been involved in a fight in the city's nightlife in the past 12 months. Other harms experienced included being verbally abused (31%), too drunk to walk (37%) and sexually molested (9%). Three-quarters (77.4%) of

participants stated that they always drank alcohol when using the city's nightlife. Only 1.3% never drank alcohol on a night out (excluded from further analyses). On average, drinkers reported consuming 20.2 units[7] on a typical night out. Males reported consuming significantly more than females (mean 23.7 units cf. 16.3 units, f=63.831). However, for both sexes, mean reported alcohol consumption on a typical night out was over five times the daily limits recommended by UK government (females, 2-3 units; males, 3-4 units [NHS, 2014]). Over half (57.6%) of participants reported drinking alcohol prior to attending nightlife (e.g. at their own or a friend's home; preloading). Preloaders reported significantly higher total alcohol consumption over a night out than those not drinking until reaching pubs, bars and nightclubs (mean 22.7 units cf. 16.8 units, f=37.803).

We used logistic regression analyses to identify factors independently associated with negative nightlife experiences and high alcohol consumption. Preloading was associated with being involved in a fight and drinking more than 20 units of alcohol on a typical night out (including preloaded alcohol consumption). Increasing levels of typical alcohol consumption over the course of a night out was associated with being sexually molested and too drunk to walk. Females were at increased risk of sexual molestation and drinking more than 20 units of alcohol over the course of the night out, whilst younger people (aged 18-24) were more likely to report being too drunk to walk. Students were less likely to be involved in a fight or drink more than 20 units on a typical night out than non-students. Finally, those who drank on more than one day in the seven days prior to survey were more likely to be involved in a fight (with those drinking 2-4 days at greatest risk). Drinking on more than one day in the seven days prior to survey was also associated with being verbally abused. The findings from the article have informed debate on the management of alcohol issues and nightlife environments at a governmental and academic level (e.g. House of Commons Health Committee, 2012; Wells et al., 2009), and national strategies to prevent alcohol-related harm (HM Government, 2012).

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[7] One unit of alcohol equals 10 millilitres (eight grams) of pure alcohol.

Hughes et al. (2008a) has some limitations typical to alcohol research. We asked participants to detail their alcohol consumption on a usual night out (including preloaded alcohol consumption). Whilst sampling in the nightlife environment may have helped participants to conceptualise their usual nightlife alcohol consumption, our findings may have been affected by recall bias or deliberate and undeliberate misreporting of amounts consumed (Aldridge and Charles, 2008). After all, survey participants are known to underestimate quantities of alcohol consumption (Kraus et al., 2005). Further, because those who were already severely intoxicated were excluded from our studies (Aldridge and Charles, 2008), the data collected can only ever underestimate consumption and related harms. Conversely, preloaded alcohol consumption may have been over estimated (Gill and Donaghy, 2004; Kraus et al., 2005).

**Submitted article**

Bellis, M.A., Hughes, K., **Quigg, Z.**, Morleo, M., Jarman, I. and Lisboa, P. (2010). Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation. *Substance Abuse Treatment, Prevention & Policy* [online], 5, 5.

**Supporting evidence**

Hughes, K., **Quigg, Z.**, Bellis, M.A., Morleo, M., Jarman, I. and Lisboa, P. (2009). *Blood alcohol levels and drunkenness amongst people visiting nightlife in the North West*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Hughes et al. (2008a) studied nightlife patrons visiting one city. In Bellis et al. (2010) and Hughes et al. (2009) we sought to obtain a better understanding of drinking patterns and levels of drunkenness in nightlife environments by asking nightlife users (n=214) in three cities to report their total alcohol consumption that day up to the point of interview (to reduce potential recall bias). Interviews were conducted throughout the night. As early interviews miss recording subsequent consumption, and later interviews may mean participants are too intoxicated to recall their consumption or participate in the study, we also asked participants to estimate their expected alcohol consumption for the remainder of their night out. In addition, we asked participants to self-assess their level of drunkenness and conducted a breathalyser test to measure breath alcohol concentration (converted to blood alcohol concentration [BAC]). Breathalyser tests have limitations associated with accuracy and appropriate usage (Kraus et al., 2005). To address this, prior to, and during our field research

I calibrated the breathalysers to ensure they were accurately recording BAC, and also provided field researchers with detailed training on their use, monitoring field researcher use of the breathalysers during the field research. My role in Bellis et al. (2010) and Hughes et al. (2009) included: working with the research co-ordinator (Professor Karen Hughes) and research lead (Professor Mark A. Bellis) to design the study methodology and research tools (i.e. a short anonymous questionnaire and observational sobriety measurement tool); calibrating the breathalysers; training and supervising field researchers; conducting field research; designing the database and entering the data; assisting with the design and implementation of data analyses; and assisting in all aspects of the production of the study report and peer reviewed paper. The study was funded by Government Office North West to help inform local nightlife strategies and prevention activity.

Half (49.5%) of participants reported feeling drunk at the point of interview, despite screening out overtly intoxicated nightlife patrons. Over half (53.3%) reported preloading. The majority (79.4%) of participants intended to consume more alcohol post interview. Consumption levels found in this study were similar to that found in Hughes et al. (2008a) and Anderson et al. (2007). Males expected to consume 27.2 units over the course of the night out and females to consume 16.5 units; 15.4% of males and 4.4% of females expected to consume over 40 units during the entire night out. At the point of interview, mean %BAC was 0.12% (12 mg alcohol per 100 ml blood). We used a GLM to predict %BAC at participants expected time of leaving the nightlife setting (home time). Our findings suggest that at home time 71.7% of males and 28.9% of females would be over 0.15%BAC (above the UK drink driving limit [0.08%BAC]). Our findings showed that higher %BAC levels were related to patrons intending to drink later into the night, suggesting that people were not taking a measured approach to alcohol consumption over longer nights introduced through the Licensing Act 2003. Rather, patrons were simply staying out later, consuming more alcohol and getting drunk. In Bellis et al. (2010) we argue that with extensive policing and subsequent management of UK nightlife environments, extending drinking hours in nightlife environments may simply act as a safe haven for drunks if drunkenness or the sale of alcohol to intoxicated patrons is not prevented.

Our study had a number of limitations beyond those noted in Hughes et al. (2008a). We aimed to reduce recall bias by asking about alcohol use that day up to the point of interview, and through using trained nightlife researchers who encouraged participants to be honest and

comprehensive about their consumption (Aldridge and Charles, 2008). However, the accuracy of expected alcohol consumption post interview is not known. Reported alcohol consumption levels were similar to those reported in Hughes et al. (2008) however, which studied a similar population. Finally, our GLM explained 40% of the variance, yet another study measuring %BAC in drinking environments resulted in poorer predictions (i.e. around 20% of variance explained; Kraus et al., 2005).

**Submitted article**

**Quigg, Z.**, Hughes, K. and Bellis, M.A. (2013). Student drinking patterns and blood alcohol concentration on commercially organised pub crawls in the UK. *Addictive Behaviors*, 38, 2924-2929.

**Supporting evidence**

**Quigg, Z.**, Hughes, K. and Bellis, M.A. (2011). *Pub crawl: alcohol use amongst students attending organised drinking events.* Liverpool: Centre for Public Health, Liverpool John Moores University.

In many nightlife areas, particularly those in and around university towns/cities, students form a key part of the night-time economy. Reported benefits of student drinking include enhanced social life and increased self-confidence (Orford et al., 2004) and alcohol consumption is often viewed by students as an accepted and routine part of student life (Carpenter et al., 2007; Wicki et al., 2010). However, excessive alcohol consumption negatively affects students' finances, studies and health (Bewick et al., 2008; Dodd et al., 2010). Consequently, student alcohol consumption and associated harms is a concern amongst student bodies and public health partners (Drinkaware/National Union of Students, 2011). Understanding student drinking patterns is obstructed by their tendency to be omitted from national household surveys on alcohol consumption (Office for National Statistics, 2013). A few studies have reported on students' usual weekly alcohol consumption (Bewick et al., 2008; Dodd et al., 2010), however reports of usual consumption tend to mask the more excessive consumption often seen during student drinking events in nightlife areas. Hughes et al. (2008a) and Bellis et al. (2010) studied a range of individuals engaged in nightlife; both were conducted in university cities inevitably recruiting students (e.g. Hughes et al., 2008a; 29% of the sample was students). However, both studies were conducted during weekend evenings, due to being the peak periods for nightlife activity. However, students often use

nightlife areas during weekday nights, thus, our findings may not be reflective of the student population.

Although a relatively new phenomenon in the UK, commercially organised pub crawls on weekday evenings are now a key feature in student life. These events encourage students to visit multiple drinking venues throughout an evening, promoting protracted and excessive alcohol consumption. The events provide business to local economies on normally quiet nights. However, the crowds of students moving between licensed premises, who can be highly intoxicated and involved in antisocial behaviour, have attracted widespread media attention (Braidwood, 2009; Dwan, 2011; Hill, 2009; Hubbard, 2011). Despite such reports, little research on this issue is available. Thus in Quigg et al. (2013) I co-designed and led a research programme (funded by Drinkaware) to explore student drinking patterns on commercially organised pub crawls in England. My role included: co-designing and planning the study methodology and research tools; managing and participating in data collection; database design and data entry; co-designing and implementing data analyses; and the production of a report (Quigg et al., 2011) and a peer reviewed journal article (Quigg et al., 2013). The study used methods similar to those used in Bellis et al. (2010) (i.e. breathalyser test and alcohol consumption survey). Two hundred and twenty seven students, attending commercial pub crawls across three events in England, took part in the study.

Half (50.7%) of participants were female and 65.6% were aged 20 years and under. A third (32.6%) reported being on the pub crawl with a group of up to five other people (excluding themselves), 43.0% with 6-10 people and 24.4% with more than 10 people. Pub crawls started between 7-8pm. At the time of interview, 79.7% had started the pub crawl (i.e. had been to at least one pub crawl bar) and 20.3% were on their way to the pub crawl. The proportion of participants having not yet attended the pub crawl ranged from 27.6% of those surveyed between 7-8.59pm, to 11.1% between 1-2.59am. Of those who had already visited at least one pub crawl bar, the median number of bars visited was three. One in ten (10.3%) participants expected to go home before 2am, 37.6% between 2-3.59am, and 52.1% after 4am.

Our study found that 90.1% of drinkers (94.3% of all participants) preloaded. At the point of interview, drinkers reported having consumed a median of 10 units, with an estimated median of 16.3 units over the entire night out. Further, at the point of interview, the median %BAC of

drinkers was 0.10%; above the UK drink driving limit (0.08%BAC). Here, high %BAC levels (>0.08%BAC) were associated with having not eaten food in the four hours prior to interview, time spent drinking and drinking rate. We argued that a wide range of partners, such as pub crawl organisers, the police, universities and students, should be involved in the effective management of commercial pub crawls. Interventions should focus on preventing high levels of risky (e.g. preloading, rapid and excessive drinking) alcohol consumption prior to, and during the pub crawl. Our study faced a number of limitations beyond those reported in Bellis et al. (2010). The three pub crawl events were organised by one organisation and thus were similar, however, there may have been site-level factors that could have influenced our study (e.g. event capacity/size of nightlife area, number of non-participating venues serving alcohol in the pub crawl locality, level of police involvement, closeness to university halls of residence). Future research would benefit from the inclusion of such site level factors, along with further examination of participant behaviour on pub crawls (e.g. total number of bars visited). My findings have been used to help develop a guidance document for law enforcement officers involved in managing commercially organised pub crawls (Drinkaware/National Union of Students, 2011), and I also sit on the National Union of Students Alcohol Impact Project academic advisory group (www.alcoholimpact.nus.org.uk/).

**Submitted article**

Hughes, K., Bellis, M.A., Leckenby, N., **Quigg, Z**., Hardcastle, K., Sharples, O. and Llewellyn, D.J. (2014). Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal of Epidemiology and Community Health* [online], 68, 453-456.

Throughout my nightlife research studies, preloading has been a common feature of patrons' alcohol consumption. This can mean that patrons enter nightlife areas already intoxicated. Motivations for preloading include a desire to get drunk, reduce social anxieties and enhance the night out (Wells et al., 2009), and/or to save money (due to lower off-licensed alcohol prices [Mintel, 2003]). In Hughes et al. (2008a), findings suggested that preloading was not a substitute for nightlife drinking, with similar amounts drank by preloaders and non-preloaders whilst in nightlife settings. Despite it being illegal to serve alcohol to drunks, it is clear from my studies that English nightlife environments are primarily occupied by drunk individuals who consume alcohol throughout their night out. This suggests that drunk people continue to get served in pubs, bars and nightclubs. To explore this further, in Hughes et al. (2014) we

used pseudo-intoxicated actors to test bar server propensity to over-serve alcohol. Over seventy randomly selected pubs, bars and nightclubs in one English city were subjected to an alcohol purchase test by pseudo-intoxicated actors. Researchers observed the test purchase, recording venue characteristics (e.g. levels of rowdiness) to identify poorly managed and problematic (PMP) bars. Our study found over-serving to be an issue, with 83.6% of purchase attempts resulting in a sale of alcohol to a pseudo-intoxicated actor. Alcohol sales increased with the number of PMP bar markers present. Whilst the study was limited to one city, we concluded that the law on preventing sales of alcohol to drunks is routinely broken in nightlife environments, and argued that preventing alcohol sales to drunks should be a public health priority. My role in Hughes et al. (2014) included: assisting in the design of the study methodology; training field researchers and actors to conduct the field research; contributing to study and fieldwork coordination; undertaking field research; and manuscript editing.

## 3.4 European research findings

**Supporting evidence**

Hughes, K., **Quigg, Z**., Bellis, M.A., Calafat, A., van Hasselt N and Košir, M. (2012) From home to pub. In: Anderson, P., Braddick, F., Reynolds, J. and Gual, A. (eds). *Alcohol Policy in Europe: Evidence from AMPHORA* [online]. Available at: http://amphoraproject.net/view.php?id_cont=45

As part of a wider research programme (AMPHORA)[8] that aimed to contribute new evidence on alcohol consumption and alcohol-related harm in Europe and to disseminate this knowledge to inform policy and practice, I co-managed a study that specifically focused on nightlife drinking environments. Our study aimed to: understand young people's drinking cultures and environments; identify factors associated with high and low alcohol-related harm in pubs, bars and nightclubs; and develop recommendations for creating safer drinking environments. Four peer reviewed journal articles were published from the study, discussed below, along with a chapter in a wider report summarising evidence from the AMPHORA project (Anderson et al., 2012). Along with jointly coordinating and implementing all aspects of the study, my specific role in Hughes et al. (2011a), Hughes et al. (2011b) and Hughes et al. (2012) included contributing to data analysis design and implementation, literature

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[8] Funded via the European Community's Seventh Framework Programme (FP7/2007-13).

searches and manuscript editing. In the final paper, Quigg et al. (2014) I conceptualised and co-designed the manuscript, co-designed and implemented data analyses and wrote the article.

**Submitted article**

Hughes, K., **Quigg, Z.**, Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Juan, M., Duch, M. and Voorham, L. (2011a). Drinking behaviours and blood alcohol concentration in four European drinking environments: a cross-sectional study. *BMC Public Health* [online], 11, 918.

In Hughes et al. (2011a) we conducted the first cross-national European nightlife study using our survey and breathalyser test approach to measure nightlife alcohol consumption. Here, a survey and breathalyser test was implemented among 838 drinkers aged 16-35 years in drinking environments in four European cities in the Netherlands, Slovenia, Spain and the UK. Over half of participants from the Dutch, Spanish and UK samples had preloaded, compared to a third of the Slovenia sample. Amongst the UK sample, %BAC increased significantly in those who had been drinking for a longer time that day, yet in other nationalities, %BAC increases were less pronounced or absent. Overall, high %BAC levels (>0.08%BAC) were associated with being British, male, aged over 19 years and having consumed spirits. Whilst our study found high levels of alcohol consumption across all country samples, there were differences observed in drinking behaviours. Whilst the UK sample saw continued increases in drunkenness as the night progressed, all other country samples saw more steady and moderate levels of intoxication. With drinking patterns, alcohol policy and commercial interests converging across Europe, we argue that it is important that drinking behaviours such as those seen in the UK sample are replaced rather than replicated across countries.

Our study had a number of limitations beyond those reported in our English studies (Bellis et al., 2010; Hughes et al., 2008a; Quigg et al., 2014). The small sample size in each city, along with an overall compliance rate of 58.9%, means that our findings should only be extrapolated with caution. Conducting the research across European cities presented a number of challenges. With peaks in nightlife activity varying between cities, the field research was not conducted at the same time across each city. Variations in alcoholic drink types and measures also meant that we had to record the numbers of different drinks

individuals reported in two size categories, and then convert these to grams of alcohol based on local standard drink sizes and strengths.

**Submitted article**

Hughes, K., **Quigg, Z**., Eckley, L., Bellis, M.A., Jones, L., Calafat, A., Košir, M. and van Hasselt, N. (2011b). Environmental factors in drinking venues and alcohol-related harm: the evidence-base for European intervention. *Addiction*, 106 (S1), 37-46.

Environmental factors in drinking venues can contribute to alcohol-related harms. Thus, as part of the AMPHORA study we conducted a systematic literature review (Hughes et al., 2011b) to: identity environmental factors in drinking establishments that are associated with increased alcohol consumption and associated harm; and to understand the extent of study in this area across Europe. Thirty four studies were identified across nine countries. The majority (23) had been implemented in non-European countries and many had collected data more than a decade prior to the review. Factors that appeared particularly important in contributing to alcohol-related problems included cheap alcohol availability, a permissive environment, poor cleanliness, loud music, crowding, a focus on dancing and poor staff practice. However, findings were not consistent across studies. Nevertheless, the review helped us develop our tools (based on those used by Graham et al. [2006] in Canada; http://publish.uwo.ca/~kgraham/safer_bars.html) that were used in the observational research part of our study (see below), adapting the tools to suit modern European nightlife settings (Hughes et al., 2012; Quigg et al., 2014).

**Submitted articles**

**Quigg, Z**., Hughes, K., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Duch, M., Juan, M., Voorham, L. and Goossens, F.X. (2014). Incidents of harm in European drinking environments and relationships with venue and customer characteristics. *International Journal of Alcohol and Drugs Research*, 3, 269-275.

Hughes, K., **Quigg, Z**., Bellis, M.A., Calafat, A., van Hasselt, N., Košir, M., Voorham, L., Goossens, F., Duch, M. and Juan, M. (2012). Drunk and disorganised: relationships between bar characteristics and customer intoxication in European drinking environments. *International Journal of Environmental Research and Public Health,* 9, 4068-4082

In Hughes et al. (2012) and Quigg et al. (2014) we implemented an observational study in 60 youth-focused bars in the four European study sites. Here, we aimed to understand the relationship between a range of individual, social and environmental factors and alcohol-related harms. We used two research tools: an observational schedule to assess the type, extent and behaviours of staff and customers in the premises, and the premise environment; and an incident form to record details of harm witnessed (e.g. someone falling over). In each venue, one-hour observational visits were undertaken during peak opening hours on four occasions by mixed gender pairs of field researchers from the city of study (except for two venues where researchers were unable to undertake a fourth visit). Study timings were dependent upon local nightlife activity in each city; all visits took place on Thursday, Friday and Saturday nights between 10pm-5am. Field researchers were instructed to behave as customers during visits but to avoid interaction with other customers wherever possible (to ensure observations were based on natural behaviours). Research tools were completed independently by field researchers following each visit and combined into a single completed schedule in a research meeting held the following week.

In Quigg et al. (2014) we investigated the types of harms experienced by nightlife patrons. Across the four cities we recorded 114 incidents of harm (34.2%, 32.4%, 30.7% and 2.6% in Ljubljana, Liverpool, Utrecht and Palma respectively). Nearly half (48.3%) of venues had one or more incident observed; 94.7% of incidents were amongst customers, with the remainder amongst staff. Falling over accounted for the highest proportion (10.1%) of incidents observed and was the most commonly recorded harm in Liverpool (23.3%; $p<0.001$). Other harms observed included people arguing (8.8% of incidents) or being so severely intoxicated that they required assistance (e.g. to walk) (5.0%). Bivariate analyses showed associations between a range of staffing, customer and environmental characteristics, and incidents of harm. Significant associations were seen with most customer-focused characteristics (excluding male clientele, young clientele and high alcohol content drinks) and for staff characteristics, younger staff and higher levels of permissiveness. Physical characteristics, including lower proportions of seating, higher levels of crowdedness, the presence of glass on the floor and toilets that had poor levels of cleanliness were all associated with incidents. Alcoholic drinks promotions were associated with incidents. The playing of rock/heavy music was associated with no incidents being observed. Of the four contextual variables analysed (city; observation time [an equal split between earlier/later observations in each city]; number of customers in the premise [>100 or not at the busiest

time]; and whether the venue had an outdoor drinking area), only city showed as having an association with any incidents being observed. Logistic regression analysis was used to identify which characteristics were independently associated with incidents being observed. Here, controlling for city and venue, in the final model only one variable remained significant - permissiveness.

In Hughes et al. (2012) we conducted exploratory analyses (i.e. analyses of variance [ANOVA]; chi squared) to identify city level comparisons of environmental characteristics recorded at each visit. Findings show significant differences between cities for most characteristics. For example, alcoholic drink promotions were most commonly seen in Liverpool. In Utrecht, the most dominant drink types consumed were low alcohol content drinks (e.g. lager), whereas in Palma high alcohol content drinks (primarily spirits) dominated. Observations in Palma recorded fewer bar staff per customer, and more female and older bar staff. Across all customer behaviour variables (e.g. dancing, rowdiness), mean ratings were lowest in Ljubljana although differences between cities were only significant for sexual competition and rowdiness. Our primary dependant variable for multivariate analyses was observed intoxication level of customers in the venue (measured on a scale of 0-9 [no sign of intoxication-everyone is drunk]). No significant differences between cities in mean ratings of customer intoxication were identified (Liverpool and Utrecht 4.0, Palma 3.7, Ljubljana 3.5, p=0.313).

Multivariate analysis used hierarchical modelling (linear mixed modelling) with venue as the unit of observation. Scale variables that were highly correlated (r>0.50; e.g. sexual activity and sexual competition [r=0.765; cronbach's alpha 0.866]) were combined into composite scales. Initially, all variables were input individually to identify associations with intoxication. Six separate multivariate models were then run each including variables relating to: (1) venue entrance; (2) physical environment; (3) bar activities; (4) alcohol and food service; (5) venue staff; and (6) customer factors. Contextual variables were also analysed including: city; observation time; number of customers in the premise; whether police were outside the venue during the observation; and whether the venue had an outdoor drinking area. All variables with independent relationships with intoxication ratings within each model were entered into the final models. The first model looked at all characteristics and identified six factors independently associated with higher intoxication ratings: later observation time; poorer washroom facilities; non-alcoholic drink promotions; plastic glassware; greater

permissiveness; and higher customer sexual activity/competition. Our second model excluded customer-focused variables as customers will be attracted to venues based on their social and physical environments. Here, all independent associations between non-customer factors and intoxication remained, and those with later observation timing, non-alcoholic drink promotions and permissiveness were strengthened. An independent relationship also emerged between intoxication ratings and the presence of a dance floor.

Our findings from Hughes et al. (2012) and Quigg et al. (2014) illustrate the extent of intoxication and alcohol-related harms experienced across European nightlife venues, and their links with a range of factors. Our findings suggest that prevention efforts should focus on improving venue management practice and behavioural expectations. Our studies do have some limitations. Inconsistencies in structural and cultural factors across the four countries may have affected our study, such as differences in licensing legislation. Whilst for most countries (excluding Palma) we randomly selected bars for inclusion in the study, venues selected were not, nor were they intended to be, representative of each city. The sample was designed to only explore venues popular with young people in each city. Finally, as with all cross-sectional surveys results we cannot establish cause and effect. However, our evidence can help inform prevention measures.

# 4. Summary

The public health approach to the prevention of violence and alcohol-related harms uses routine data sources and original research to inform the development of appropriate preventive interventions, of which this thesis demonstrates. The thesis has presented a body of work illustrating the important role of health data in the prevention of violence and alcohol-related harms in nightlife and other settings. Further, through conducting primary research within nightlife settings, the studies presented have unearthed the extent of harms experienced by nightlife patrons and drinking behaviours that are not illustrated in national surveys or routine data sources. The key findings from these studies include:

- EDs can have an instrumental role in developing understanding of local issues around alcohol and violence. Data sharing systems can be effectively established to enable ED data to be used to inform, target and evaluate violence and alcohol-related harm prevention activity in nightlife environments, and elsewhere. Further, they can identify at-risk groups and communities where primary prevention can best be targeted. ED data can identify issues in nightlife environments that may otherwise go unknown to the police or other agencies, and that may warrant further research.

- A wide range of harms are experienced by nightlife patrons including verbal and physical aggression, sexual molestation and excessive drunkenness. Risk factors for alcohol-related harms in nightlife occur at an individual and environmental level. English nightlife settings are the scenes of excessive alcohol consumption with preloading a common feature. Subsequently, many patrons enter nightlife areas already drunk. Despite being illegal, over-serving to drunks is common.

In the UK, the prevention of harms in nightlife settings has primarily focused on developing safe nightlife environments. Few interventions have been developed that aim to tackle the culture of drunkenness, risky drinking behaviours (e.g. preloading) and the over service of alcohol to drunks that have been evidenced in my studies. With the links between alcohol and harms such as violence being well established, addressing the culture of drunkenness within nightlife settings has to be a key public health priority. Both primary research and analyses of

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routine data sources can support this approach by identifying at-risk communities where primary prevention interventions should best be targeted.

My current research is continuing to develop understanding of the use of health data in violence prevention in nightlife settings and elsewhere. While health data are not routinely used across the UK or internationally to inform prevention activity, I am currently engaged in two projects (for the Home Office and Department of Health) that aim to identify and illustrate the optimum use of health data in violence prevention. In addition, I am working on a range of other projects to develop nightlife research and further engage health professionals in the prevention of nightlife-related harms. For example, I am working with the Paramedic Research Network (based at LJMU) to develop a programme of research to support the paramedic profession including studies on the extent of violence-related ambulance call outs, at-risk groups, locations and trends. Further, following findings from Hughes et al. (2014) and Quigg et al. (2013), my research colleagues and I have implemented research to further explore drinking behaviours (Quigg et al., 2015a; Quigg et al., 2015b) and sexual harassment in nightlife settings (Hardcastle et al., 2015), and are working with partners to develop and evaluate interventions aimed at preventing the service of alcohol to intoxicated nightlife patrons in England and Wales (Quigg et al., 2015a; Quigg et al., 2015b).

# 5. References

Alcohol Concern (2014). *Alcohol and football*. London: Alcohol Concern.

Aldridge, J. and Charles, V. (2008). Researching the intoxicated: informed consent implications for alcohol and drugs research. *Drug and Alcohol Dependence* [online], 93, 191-196. Available at: http://dx.doi.org/10.1016/j.drugalcdep.2007.09.001. [Accessed 11.06.14].

Anderson, Z., Hughes, K. and Bellis, M.A. (2007) *Exploration of young people's experience and perceptions of violence in Liverpool's nightlife*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Anderson, Z., Whelan, G., Hughes, K. and Bellis, M.A. (2009*). Evaluation of the Lancashire polycarbonate glass pilot project.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Bellis, M.A., Anderson, Z. and Hughes, K. (2006). *Effects of the Alcohol Misuse Enforcement Campaigns and the Licensing Act 2003 on violence*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Bellis, M.A. and Hughes, K. (2011). Getting drunk safely? Night-life policy in the UK and its public health consequences. *Drug and Alcohol Review* [online], 30, 536-545. Available at: http://dx.doi.org/10.1111/j.1465-3362.2011.00290.x. [Accessed 11.06.14].

Bellis, M.A., Hughes, K., Anderson, Z., Tocque, K. and Hughes, S. (2008). Contribution of violence to health inequalities in hospital admissions for assault in England: demographics and trends in emergency hospital admissions for assault. *Journal of Epidemiology and Community Health* [online], 62, 1064-1071. Available at: http://jech.bmj.com/content/62/12/1064.full.pdf+html. [Accessed 11.06.14].

Bellis, M.A., Hughes, K., Quigg, Z., Morleo, M., Jarman, I. and Lisboa, P. (2010). Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their

relationships with drinking behaviours and observed signs of inebriation. *Substance Abuse Treatment, Prevention and Policy* [online], 5, 5.

Available at: http://www.substanceabusepolicy.com/content/5/1/5. [Accessed 30.07.14].

Bellis, M.A., Hughes, K., Perkins, C., and Bennett, A. (2012a). *Protecting people. Promoting health. A public health approach to violence prevention for England*. Liverpool: North West Public Health Observatory.

Bellis, M.A., Leckenby, N., Hughes, K., Wyke, S., Quigg, Z. and Luke, C. (2012b). Nighttime assaults: using a national emergency department monitoring system to predict occurrence, target prevention and plan services. *BMC Public Health* [online], 12, 746. Available at: http://www.biomedcentral.com/1471-2458/12/746. [Accessed 11.06.14].

Bewick, B.M., Mulhern, B., Barkham, M., Trusler, K., Hill, A.J., and Stiles, W.B. (2008). Changes in undergraduate student alcohol consumption as they progress through university. *BMC Public Health* [online], 8, 163.

Available at: http://dx.doi.org/10.1186/1471-2458-8-163. [Accessed 11.06.14].

Birkenhead and Wallasey Primary Care Trust. (2004). *Wirral evening and night time strategy 2004-2008*. Wirral: Birkenhead and Wallasey Primary Care Trust.

Boyle, A., Shepherd, J., and Sheehan, D. (2009) *Guideline for information sharing to reduce community violence* [online]. London: The College of Emergency Medicine. Available at: www.collemergencymed.ac.uk/code/document.asp?ID=4881. [Accessed 31.07.14].

Boyle, A. and Snelling, K. (2011). Information sharing to reduce community violence: culture shift and incentives are needed. *British Medical Journal* [online], 343:d4452. Available at: http://dx.doi.org/10.1136/bmj.d3313. [Accessed 11.06.14].

Braidwood, J. (2009). *Student group wants ban on mass pub crawl* [online]. Sky news online. 9/11/09. Available at:

http://news.sky.com/skynews/Home/UK-News/Carnage-UK-National-Union-Of-Students-Calls-For-Ban-On-Organised-Student-Pub-Crawl/Article/200911215447117.

[Accessed 31.07.14].

Cabinet Office. (2010). *The Coalition: our programme for government*. London: HM Government.

Carpenter, R., Fishlock, A., Mulroy, A., Oxley, B., Russell, K., Salter, C., Williams, N. and Heffernan, C. (2007). After 'Unit 1421': an exploratory study into female students' attitudes and behaviours towards binge drinking at Leeds University. *Journal of Public Health* [online], 30, 8-13.
Available at: http://dx.doi.org/10.1093/pubmed/fdm083. [Accessed 11.06.14].

Centre for Public Innovation/Gecko Social Health Outcomes. (2012). *Information sharing to tackle violence. Audit of progress on delivering the Coalition Commitment 2012*. Available at: www.publicinnovation.org.uk/sharing-to-tackle-violence/. [Accessed 18.07.14].

Charalambous, M.P. (2002). Alcohol and the accident and emergency department. A current review. *Alcohol and Alcoholism*, 37, 307-312.

Connecting for Health. (nd). *Commissioning datasets introduction* [online]. Available at: http://www.datadictionary.nhs.uk/web_site_content/navigation/commissioning_data_sets_menu.asp. [Accessed 11.06.14].

Davidson, T., van Staden, L., Nicholas, S. and Feist, A. (2010*). Process evaluation of data sharing between emergency departments and community safety partnerships in the South East*. London: Home Office.

Dellar, A. and Pownall, P. (2007). *Tactical options for dealing with alcohol-related violence identified through the tackling violent crime programme*. London: Central Office for Information/Home Office.

Department of Health, Home Office, Department for Education and Skills, Department for Culture, Media and Sport. (2007). *Safe. Sensible. Social. The next steps in the National Alcohol Strategy*. London: HM Government.

Dodd, L.J., Al-Nakeeb, Y., Nevill, A. and Forshaw, M.J. (2010). Life risk factors of students: a cluster analytical approach. *Preventive Medicine* [online], 51, 73-77. Available at: http://dx.doi.org/10.1016/j.ypmed.2010.04.005. [Accessed 11.06.14].

Drinkaware/National Union of Students, (2011). *Guidance notes for law enforcement officers: pub/bar crawls* [online]. Available at: https://resources.drinkaware.co.uk/Guidance-Notes-for-Law-Enforcement-Officers-Pub-Bar-Crawls. [Accessed 25.07.13].

Droste, N., Miller, P. and Baker T. (2014). Review article: emergency department data sharing to reduce alcohol-related violence: a systematic review of the feasibility and effectiveness of community-level interventions. *Emergency Medicine Australasia*, 26, 326-335.

Dwan, J. (2011). *Five arrested during student pub crawl* [online]. Essex County Standard. 15/03/11. Available at:
http://www.essexcountystandard.co.uk/news/8910452.Five_arrested_during_student_pub_Crawl/. [Accessed 31.07.14].

Faergemann, C., Lauritsen, J.M., Brink, O. and Skov, O. (2007). Trends in deliberate interpersonal violence in the Odense Municipality, Denmark 1991–2002. The Odense study on deliberate interpersonal violence. *Journal of Forensic and Legal Medicine* [online], 14, 20-26. Available at: http://dx.doi.org/10.1016/j.jcfm.2006.01.001. [Accessed 11.06.14].

Fell, R., Tocque, K., Hockey, G., and Bellis, M.A. (2002). *Accident, injury and trauma information and intelligence initiatives in Merseyside, the North West and Nationwide.* Liverpool: North West Public Health Observatory, Centre for Public Health, Liverpool John Moores University.

Flatley, J. (2014). *Focus on: violent crime and sexual offences, 2012/13.* London: Office for National Statistics. Available at: www.ons.gov.uk/ons/rel/crime-stats/crime-statistics/focus-on-violent-crime-and-sexual-offences--2012-13/index.html. [Accessed 06.05.14].

Florence, C., Shepherd, J., Brennan, I., and Simon, T. (2011). Effectiveness of anonymised information sharing and use in health service, police, and local government partnership for

preventing violence related injury: experimental study and time series analysis. *British Medical Journal* [online], 342:d3313. 42:d3313. Available at: http://dx.doi.org/10.1136/bmj.d3313. [Accessed 11.06.14].

Ford, K., Wood, S., Hughes, K. and Quigg, Z. (2014). *Accident and emergency department data sharing to support violence prevention in Wirral*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Gill, J. S. and Donaghy, M. (2004). Variation in the alcohol content of a 'drink' of wine and spirit poured by a sample of the Scottish population. *Health Education Research*, 19, 485-491.

Graham, K., Osgood, D.W., Zibrowski, E., Purcell, J., Gliksman, L., Leonard, K., Pernanen, K., Saltz, R.F., and Toomey TL. (2004). The effect of the Safer Bars programme on physical aggression in bars: results of a randomized controlled trial. *Drug and Alcohol Review*, 23, 31-41.

Hadfield, P. and Newton, A. (2010). *Factsheet. Alcohol, crime and disorder in the night-time economy* [online]. London: Alcohol Concern.  Available at:
http://www.alcoholconcern.org.uk/assets/files/Publications/Night-time-Economy-factsheet.pdf. [Accessed 11.06.14].

Hardcastle, K., Hughes, K. and Quigg, Z. (2014). *Perceptions and impact of the Shrewsbury Safer Nights minor injury unit*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Hardcastle, K., Hughes, K. and Quigg, Z. (2015). *Experiences and attitudes towards unwanted sexual touching in the night time economy*. Liverpool: Centre for Public Health, Liverpool John Moores University.

HES Data Quality Team. (2014). *HES 2012-13 A&E data quality note* [online]. London: Health and Social Care Information Centre. Available at:
http://www.hscic.gov.uk/catalogue/PUB13464. [Accessed 25.07.14].

Hill, A. (2009). *Student pub crawls face ban amid backlash over drunken disorder* [online] The Observer. 8/11/09. Available at:

http://www.theguardian.com/education/2009/nov/08/philip-laing-carnage-binge-drinking. [Accessed 31.07.14].

HM Government. (2010) *Indices of Deprivation 2007 for Super Output Areas* [online]. Available at: http://data.gov.uk/dataset/index_of_multiple_deprivation_imd_2007. [Accessed 9.05.11].

HM Government. (2012). *The Government's Alcohol Strategy*. London: Home Office.

Home Office. (2008). *Saving lives. Reducing Harm. Protecting the public. An action plan for tackling violence 2008-11*. London: HM Government.

Homel, R., Hauritz, M., Wortley, R., McIlwain, G., and Carvolth, R. (1997). Preventing alcohol-related crime through community action: the surfers paradise safety action project. In Homel, R., (Ed.). *Policing for prevention: reducing crime, public intoxication and injury* (35-90). Monsey: Criminal Justice Press.

Hough, M. and Hunter, G. (2008). The 2003 Licensing Act's impact on crime and disorder. An evaluation. *Criminology and Penology*, 8(3), 239-260.

House of Commons Health Committee. (2012). *Government's Alcohol Strategy. Third report of session 2012-13*. London: The Parliamentary Bookshop.

Hubbard, P. (2011). Carnage! Coming to a town near you? Nightlife, uncivilised behaviour and the carnivalesque body. *Leisure Studies* [online], 32(3), 265-282. Available at: http://dx.doi.org/10.1080/02614367.2011.633616. [Accessed 31.07.14].

Hughes, K. and Anderson, Z. (2008). *Identifying drunkenness and preventing sales of alcohol to intoxicated customers in Manchester.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Hughes, K., Anderson, Z., Morleo, M., Bellis, M.A. (2008a). Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction*, 103(1), 60-65.

Hughes, K., Bellis, M.A., Leckenby, N., Quigg, Z., Hardcastle, K., Sharples, O. and Llewellyn, D.J. (2014). Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal of Epidemiology and Community Health* [online], 68, 453-456. Available at: http://jech.bmj.com/content/68/5/453. [Accessed 11.06.14].

Hughes, K., Bellis, M.A., Calafat, A., Juan, M., Schnitzer, S. and Anderson, Z. (2008b). Predictors of violence in young tourists: a comparative study of British, German and Spanish holidaymakers. *European Journal of Public Health* [online], 18: 569-574. Available at: http://eurpub.oxfordjournals.org/content/18/6/569.long. [Accessed 11.06.14].

Hughes, K., Quigg, Z., Bellis, M.A., Calafat, A., van Hasselt, N. and Košir, M. (2012) From home to pub. In: Anderson, P., Braddick, F., Reynolds, J. and Gual, A. (eds). *Alcohol Policy in Europe: Evidence from AMPHORA* [online]. Available at: http://amphoraproject.net/view.php?id_cont=45. [Accessed 29/7/14].

Hughes, K., Quigg, Z., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Juan, M., Duch, M. and Voorham, L. (2011a). Drinking behaviours and blood alcohol concentration in four European drinking environments: a cross-sectional study. *BMC Public Health* [online], 11, 918. Available at: http://www.biomedcentral.com/1471-2458/11/918. [Accessed 11.06.14].

Hughes, K., Quigg, Z., Bellis, M.A., Calafat, A., van Hasselt, N., Košir, M., Voorham, L., Goossens, F., Duch, M. and Juan, M. (2012). Drunk and disorganised: relationships between bar characteristics and customer intoxication in European drinking environments. *International Journal of Environmental Research and Public Health,* 9, 4068-4082.

Hughes, K., Quigg, Z., Bellis, M.A., Morleo, M., Jarman, I. and Lisboa, P. (2009). *Blood alcohol levels and drunkenness amongst people visiting nightlife in the North West*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Hughes, K., Quigg, Z., Eckley, L., Bellis, M.A., Jones, L., Calafat, A., Košir, M. and van Hasselt, N. (2011b). Environmental factors in drinking venues and alcohol-related harm: the evidence-base for European intervention. *Addiction*, 106 (S1), 37-46.

Information Standards Board for Health and Social Care (2014). *ISTV Initial Standard: Specification*. London, Health and Social Care Information Centre. Available from: http://www.isb.nhs.uk/documents/isb-1594/amd-31-2012/1594312012spec.pdf. [Accessed 19th November 2014].

Kraus, C.L., Salazar, N.C., Mitchell, J.R., Florin, W.D., Guenther, B., Brady, D., Swartzwelder, S.H., and White, A.M. (2005). Inconsistencies between actual and estimated blood alcohol concentrations in a field study of college students: do students really know how much they drink? *Alcoholism: Clinical and Experimental Research*, 29, 1672-1676.

Krug, G., Dahlberg, L.L, Mercy, J.A., Zwi, A.B., and Lozano, R. (2002). *World report on violence and health.* Geneva: World Health Organization.

Luke, L.C., Dewar, C., Bailey, M., McGreevy, D., Morris, H., and Burdett-Smith, P. (2002). A little nightclub medicine: the healthcare implications of clubbing. *Emergency Medicine Journal,* 19, 542-545.

McVeigh, C., Hughes, K., Bellis, M.A., Reed, E., Ashton, J.R. and Syed, Q. (2005). *Violent Britain. People, prevention and public health*. Liverpool: Centre for Public health, Liverpool John Moores University.

Mintel. (2003). *In- vs out-of-home drinking-UK-November 2003*. London: Mintel International Group Ltd.

Morleo, M., Jones, A., O'Keefe, M., Leckenby, N., McHale, P., Perkins, C., Hughes, K. and Bellis, M.A. (2013). *The impact of London 2012 Olympic and Paralympic Games on alcohol-related illness and injury*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Morleo, M., Lightowlers, C., Anderson, Z., Cook, P.A., Harkins, C. and Bellis, M.A. (2009). A review of the impact of the Licensing Act on levels of violence in England and Wales: a public health perspective. *Crime Prevention and Community Safety* [online], 11, 204-218. Available at: http://www.palgrave-journals.com/cpcs/journal/v11/n3/full/cpcs200914a.html. [Accessed 11.06.14].

Newton, A., Sarker, S.J., Pahal, G.S., van den Bergh, E. and Young, C. (2007). Impact of the new UK licensing law on emergency hospital attendances: a cohort study. *Emergency Medicine Journal,* 24, 532-534.

NHS. (2014). *Alcohol units and guidelines* [online]. Available at: http://www.nhs.uk/change4life/Pages/alcohol-lower-risk-guidelines-units.aspx. [Accessed 11/06/14].

Office for National Statistics. (2013). *Chapter 2 - Drinking (General Lifestyle Survey Overview - a report on the 2011 General Lifestyle Survey)* [online]. Available at: www.ons.gov.uk/ons/rel/ghs/general-lifestyle-survey/2011/index.html. [Accessed 11.06.14].

Orford, J., Krishnan, M., Balaam, M., Everitt, M., and van Der Graaf, K. (2004). University student drinking: the role of motivational and social factors. *Drugs: Education, Prevention and Policy* [online], 11, 407-421. Available at: http://dx.doi.org/10.1080/09687630310001657944). [Accessed 11.06.14].

Perham, N., Moores, S.C., Shepherd, J. and Busens, B. (2007). Identifying drunkenness in the night-time economy. *Addiction* [online], 102, 377-380. Available at: http://dx.doi.org/10.1111/j.1360-0443.2006.01699.x. [Accessed 11.06.14].

Pirmohamed, M., Brown, C., Owens, L., Luke, C., Gilmore I.T., Breckenridge, A.M. and Park, B.K. (2000). The burden of alcohol misuse on an inner-city general hospital. *QJM: an International Journal of Medicine*, 93, 291-295.

Quigg, Z. and Brizell, J. (2012). *Injuries during the Winter*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Quigg, Z., Ford, K., Butler, N., Hardcastle, K. and Hughes K. (2015). *Evaluation of the South Wales Know the Score intervention.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Quigg, Z., Hughes, K., Ford, K., Hunt, A., Hardcastle, K. and McGee, C. (2015). *Evaluation of the Liverpool Say No To Drunks pilot intervention.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Quigg, Z. and Hughes, K. (2010). *Identifying environmental factors related to alcohol-related harm in European bars. Field researcher training manual.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Quigg, Z., Hughes, K. and Bellis, M.A. (2011). *Pub crawl: alcohol use amongst students attending organised drinking events.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Quigg, Z., Hughes, K. and Bellis, M.A. (2012a). Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms. *Injury Prevention*, 18, 315-320.

Quigg, Z., Hughes, K. and Bellis, M.A. (2012b). Effects of the 2010 World Cup football tournament on emergency department assault attendances in England. *European Journal of Public Health*, 23, 383-385.

Quigg, Z., Hughes, K. and Bellis, M.A. (2013). Student drinking patterns and blood alcohol concentration on commercially organised pub crawls in the UK. *Addictive Behaviors*, 38, 2924-2929.

Quigg, Z., Hughes, K., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Duch, M., Juan, M., Voorham, L. and Goossens, F.X. (2014). Incidents of harm in European drinking environments and relationships with venue and customer characteristics. *International Journal of Alcohol and Drugs Research*, 3, 269-275.

Quigg, Z., Rooney, J. and Perkins, C. (2012). *Violence-related ambulance call outs in the North West of England 2010/2011.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Schnitzer, S., Bellis, M.A., Anderson, Z., Hughes, K., Calafat, A., Juan, M. and Kokkevi, A. (2010). Nightlife violence-a gender specific view on risk factors for violence in nightlife settings; a cross sectional study in nine European countries. *Journal of Interpersonal Violence,* 25(6), 1094-1112.

Sivarajasingam, V., Wells, J.P., Moore, S., Morgan, P and Shepherd J.P. (2008). *Violence in England and Wales in 2010. An accident and emergency perspective.* Cardiff: Cardiff University.

Strategy Unit (2003). *Strategy Unit alcohol harm reduction project interim analytical report.* London: Strategy Unit.

Strategy Unit (2004). *Alcohol harm reduction strategy for England. March 2004*. London: Cabinet Office, Prime Minister's Strategy Unit.

Stuart, J., Anderson, Z. and Hughes K. (2009). *Exploration of nightlife and associated problems in Prescot, Knowsley.* Liverpool: Centre for Public Health, Liverpool John Moores University.

Sutherland, I.V., Sivarajasingam, V. and Shepherd, J. (2002). Recording of community violence by medical and police services. *Injury Prevention* [online], 8, 246-247. Available at: http://dx.doi.org/10.1136/ip.8.3.246. [Accessed 11.06.14].

Teff, M. (2012). *Information sharing to tackle violence. Guidance for community safety partnerships on engaging with the NHS.* London: Department of Health.

The Centre for Public Innovation/Gecko Social Health Outcomes. (2012). *Information sharing to tackle violence. Audit of progress on delivering the Coalition Commitment 2012* [online]. Available at: www.publicinnovation.org.uk/sharing-to-tackle-violence [Accessed 23.04.13].

Upton, V., Bellis, M. and Perkins, C. (2012). *Violence-related accident and emergency department attendances by English local authority area.* Liverpool: North West Public Health Observatory.

Warburton, A.L. and Shepherd, J.P. (2004). Development, utilisation, and importance of accident and emergency department derived assault data in violence management. *Emergency Medicine Journal,* 21, 473-477.

Wells, S., Graham, K. and Purcell, J. (2009). Policy implications of the widespread practice of 'pre-drinking' or 'pre-gaming' before going to public drinking establishments: are current prevention strategies backfiring? *Addiction* [online], 104, 4-9. Available at: http://dx.doi.org/10.1111/j.1360-0443.2008.02393.x. [Accessed 23.04.13].

Wicki, M., Kuntsche, E. and Gmel, G. (2010). Drinking at European universities? A review of students' alcohol use. *Addictive Behaviors [online]*, 35, 913-924. Available at: http://dx.doi.org/10.1016/j.addbeh.2010.06.015. [Accessed 23.04.13].

Wood, S. (2014a). *Violence profile: Wirral. Use of NHS data in local violence prevention*. Liverpool: Centre for Public Health, Liverpool John Moores University.

Wood, S., Ford, K., Quigg, Z. and Hughes, K. (2014b). *Using health data to inform local violence prevention.* Liverpool: Centre for Public Health, Liverpool John Moores University.

World Health Organization (2006). *Interpersonal violence and alcohol*. Geneva: World Health Organization.

World Health Organization (2007). *Alcohol and injury in emergency departments, Summary of the report from the WHO collaborative study on alcohol and injuries*. Geneva: World Health Organization.

World Health Organization (2014a). *Global status report on alcohol and health 2014*. Geneva: World Health Organization.

World Health Organization (2014b). *Global status report on violence prevention 2014*. Geneva: World Health Organization.

# 6. Appendix: Submitted papers

**Page 61-67: Quigg, Z**., Hughes, K., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Duch, M., Juan, M., Voorham, L. and Goossens, F.X. (2014). Incidents of harm in European drinking environments and relationships with venue and customer characteristics. *International Journal of Alcohol and Drugs Research*, 3, 269-275.

**Page 68-73: Quigg, Z**., Hughes, K. and Bellis, M.A. (2013). Student drinking patterns and blood alcohol concentration on commercially organised pub crawls in the UK. *Addictive Behaviors*, 38, 2924-2929.

**Page 74-80: Quigg, Z**., Hughes, K. and Bellis, M.A. (2012a). Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms. *Injury Prevention*, 18, 315-320.

**Page 81-83: Quigg, Z**., Hughes, K. and Bellis, M.A. (2012b). Effects of the 2010 World Cup football tournament on emergency department assault attendances in England. *European Journal of Public Health*, 23, 383-385.

**Page 84-87:** Hughes, K., Bellis, M.A., Leckenby, N., **Quigg, Z**., Hardcastle, K., Sharples, O. and Llewellyn, D.J. (2014). Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city. *Journal of Epidemiology and Community Health* [online], 68, 453-456. Available at: http://jech.bmj.com/content/68/5/453.

**Page 88-100:** Bellis, M.A., Leckenby, N., Hughes, K., Wyke, S., **Quigg, Z**. and Luke, C. (2012b). Nighttime assaults: using a national emergency department monitoring system to predict occurrence, target prevention and plan services. *BMC Public Health* [online], 12, 746. Available at: http://www.biomedcentral.com/1471-2458/12/746.

**Page 101-115:** Hughes, K., **Quigg, Z**., Bellis, M.A., Calafat, A., van Hasselt, N., Košir, M., Voorham, L., Goossens, F., Duch, M. and Juan, M. (2012). Drunk and disorganised: relationships between bar characteristics and customer intoxication in European drinking environments. *International Journal of Environmental Research and Public Health,* 9, 4068-4082.

**Page 116-126:** Hughes, K., **Quigg, Z**., Bellis, M.A., van Hasselt, N., Calafat, A., Košir, M., Juan, M., Duch, M. and Voorham, L. (2011a). Drinking behaviours and blood alcohol concentration in four European drinking environments: a cross-sectional study. *BMC Public Health* [online], 11, 918. Available at: http://www.biomedcentral.com/1471-2458/11/918.

**Page 127-136:** Hughes, K., **Quigg, Z**., Eckley, L., Bellis, M.A., Jones, L., Calafat, A., Košir, M. and van Hasselt, N. (2011b). Environmental factors in drinking venues and alcohol-related harm: the evidence-base for European intervention. *Addiction*, 106 (S1), 37-46.

**Page 137-144:** Bellis, M.A., Hughes, K., **Quigg, Z**., Morleo, M., Jarman, I. and Lisboa, P. (2010). Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation. *Substance Abuse Treatment, Prevention and Policy* [online], 5, 5. Available at: http://www.substanceabusepolicy.com/content/5/1/5.

**Page 145-150:** Hughes, K., **Anderson, Z**., Morleo, M., Bellis, M.A. (2008a). Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction*, 103(1), 60-65.

# Incidents of harm in European drinking environments and relationships with venue and customer characteristics

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## Abstract

**Aim:** Research shows there are associations between bar environments and alcohol-related harms. However, few European studies have examined such links. Our study investigates the type of harms experienced by patrons in European bars, and their relationships with individual, social and environmental factors.

**Design:** Unobtrusive one-hour observational visits. Characteristics of the bar environment, staff and patrons, and harms observed were recorded on structured schedules.

**Setting:** Bars in four cities in the Netherlands, Slovenia, Spain and the United Kingdom (U.K.).

**Participants:** 238 observations across 60 bars.

**Measures:** Analyses utilized chi-squared, analyses of variance and logistic regression.

**Findings:** 114 incidents of harm were observed; in one-fifth of visits, at least one incident was recorded. People falling over, arguing or being so severely intoxicated that they required assistance to walk were the most common incidents observed. Bivariate analyses showed associations between a range of staffing, customer and environmental characteristics, and incidents of harm. Controlling for city and venue, only a permissive environment remained significant in multivariate analyses.

**Conclusions:** Harms occurring in nightlife venues are typically minor. However, such incidents have the potential to escalate into more serious harms; thus, prevention is crucial. Prevention should focus on improving venue management practice and on the behavioral standards expected of customers.

Nightlife settings are known to be common locations for alcohol-related harms, including physical and verbal aggression, drunkenness and unintentional injury (Hughes, Anderson, Morleo, & Bellis, 2008; Luke et al., 2002; Schnitzer et al., 2010). Research on alcohol-related harms in nightlife environments across Europe is rare, but there have been a few studies which have indicated the extent of such harms. A study of 16- to 35-year-olds in nine European cities found that the proportion of participants who reported involvement in violence in nightlife in the past 12 months ranged from 7.5% in Ljubljana, Slovenia, to 29.1% in Berlin, Germany (Schnitzer et al., 2010). In their study into nightlife drinking behaviors in young people across four European cities, Hughes et al. (2011a) found

that over 60% of participants expected to binge drink on the night of survey.

Alcohol-related harms occurring within nightlife venues that come to the attention of authorities tend to involve more serious outcomes, such as violence (Luke et al., 2002). However, more minor incidents that are often accepted or unreported, such as patrons arguing or being too drunk to walk (Hesse, Tutenges, Pedersen, & Kofoed, 2012; Hughes et al., 2008; Tutenges, 2012), have the potential to escalate into more serious problems, including violence and unintentional injury. Research shows that a large proportion of alcohol-related problems in nightlife are often focused around a small number of venues (Briscoe & Donnelly, 2003; Newton & Hirschfield, 2009), suggesting

that certain factors about these venues may impact on patrons' experience of harms. A wide range of individual, social and environmental factors have been shown to contribute to alcohol-related harm in nightlife venues. These include a permissive environment, cheap alcohol availability, poor cleanliness, crowding, loud music, a focus on dancing, and poor staff practice (Hughes et al., 2011b). Most of this research, however, has been conducted in North America (Graham et al., 2004) and Australia (Homel, Carvolth, Hauritz, McIlwain, & Teague, 2004).

Findings from studies on the bar environment have facilitated the development of interventions to reduce alcohol use and related harm (e.g., staff training in Canada (Graham et al., 2004), and codes of practice for drinking venues in Australia (Homel, Hauritz, Wortley, McIlwain, & Carvolth, 1997)), which have been associated with observed reductions in alcohol-related outcomes in venues where the interventions were implemented (Graham et al., 2004; Homel et al., 1997). Similar prevention measures have been implemented in some European countries (Hughes, Furness, Jones, & Bellis, 2010; Mansdotter, Rydberg, Wallin, Lindholm, & Andréasson, 2007). However, as there has been limited research on the type and extent of harms occurring within European nightlife venues and on the relationships of these harms to individual, social and environmental factors, little is known about how relevant international research findings are to Europe. To address this gap, we undertook a quantitative observational study in youth-focused bars in four European cities.

## Methods

The study took place in four European cities: Liverpool, U.K.; Ljubljana, Slovenia; Palma de Mallorca, Spain; and Utrecht, the Netherlands (for further information on each city, see Hughes et al., 2011a). Sixty venues were identified for inclusion in the study, 15 within each study site. In Liverpool, Ljubljana, and Utrecht, a list of all youth-focused bars (identified through consultation with local authorities, and based on research knowledge of the nighttime economy) in the main nightlife area(s) of each city were obtained from local police or other relevant authorities. Bars were then categorized into low, medium or high-risk premises, based on local intelligence of alcohol-related harm. From each sub-group of venues, five premises were randomly selected for inclusion in the study. In Palma, low, medium and high-risk venues for inclusion in the study were selected based on consultation with local nightlife users.

Two research tools were used: an observation schedule to assess the premises (see Hughes et al., 2012) and an incident form to record details of incidents of harm witnessed during visits. Both tools were based on those used by Graham et al. (2006) in Canada (see http://publish.uwo.ca/~kgraham/safer_bars.html). The schedule included a range of scale variables and other questions covering these factors: the venue entrance (e.g.,

whether door staff were present); the bar environment (e.g., cleanliness); bar activities (e.g., dancing); alcohol and food service; customer type (e.g., young clientele) and behaviors (e.g., level of dancing); and staffing characteristics (e.g., male) and behaviors (e.g., attitude). For all scale variables, the schedule specified the scale range (e.g., level of intoxication among customers in the venue ranged from 0 = no sign of intoxication, to 9 = everyone is drunk). The observational schedule allowed researchers to record the number of incidents of harm they observed among customers and/or staff from a pre-selected list (e.g., someone falling over drunk), with an option to record other harms unlisted. For each incident observed, researchers were requested to complete a separate incident form to record details of the circumstances of the incident and the individuals involved (data not reported here). To ensure consistency in implementing the study and completing the schedule and incident forms, research coordinators from each study site undertook a training session. The training included a test bar observation, with research coordinators completing the schedule (and incident forms if necessary) independently after the visit and comparing and discussing ratings at a meeting the following day. The training program was then repeated by research coordinators, in their respective countries, with recruited field researchers (see Hughes et al., 2011a; 2012).

In each venue, unobtrusive one-hour observational visits were undertaken during peak opening hours, on four separate occasions, by a mixed-gender pair. To ensure observations were based on natural behaviors, staff and patrons within venues were not informed that they were being observed. The exact hours of study varied from city to city depending upon local nightlife activity, but all visits took place on Thursday, Friday, and Saturday nights (September to December 2010) between 10 p.m. and 5 a.m. A total of 238 visits were undertaken (two of the premises were visited three, rather than four, times). Field researchers were instructed to behave as customers during visits (wearing clothing appropriate to the venue) and avoid interaction with other customers wherever possible; they were permitted to consume one alcoholic drink per visit. Researchers were instructed to independently complete the observational schedule and any incident forms following each visit, after leaving the venue. Covert note taking was permitted (e.g., on mobile phones) during the visit. During the following week, research coordinators held a meeting with fieldworkers in which paired schedules were checked against each other, and differences between them were discussed and resolved. Thus, each visit resulted in a single completed schedule. Incident forms were assessed for completeness and, where possible, further details obtained. Ethical approval for the study was obtained from the research ethics committee at Liverpool John Moores University in the U.K.

Data from all four cities were entered into SPSS version 17 for analysis. An additional variable (the primary dependent variable) was derived to indicate whether any incidents among customers or staff had been witnessed during the visit. Data completeness was high (> 98%) across all variables except individual drink prices (only 67% of visits

provided all four drink prices asked for, although 98% had at least one drink price recorded). Missing values were imputed as the city mean for scale variables, or the venue norm for dichotomous variables. Bivariate analyses utilized chi-squared ($X^2$) and analyses of variance (ANOVA). Backward conditional logistic regression was used to identify which staffing, customer and environmental characteristics of bars were independently associated with incidents of harm. Prior to adding significant variables from the bivariate analyses into the model, all scale variables were correlated. The following variables were identified as highly correlated (r > 0.6): sexual activity/sexual competition ($r = 0.77$); crowdedness/movement ($r = 0.69$); and seating/dancing ($r = 0.62$). These variables were combined, standardized, and added to the model with all other significant variables from the bivariate analyses, along with a venue code (i.e., a unique identifier assigned to each venue) to control for repeated visits.

## Results

In total, 238 visits were completed in 60 bars across four cities. One hundred and fourteen incidents were observed (see Table 1 for examples of incident descriptions); 34.2% in Ljubljana, 32.4% in Liverpool, 30.7% in Utrecht and 2.6% in Palma. At least one incident was observed in over a third (35.0%) of visits in Liverpool, 25.0% of visits in Ljubljana, 20.7% of visits in Utrecht, and 3.3% of visits in Palma ($X^2$ [3] = 18.95, $p < .001$). Overall, 48.3% of all venues had at least one visit where an incident was observed (i.e., over typically four hours of observation). The majority (94.7%) of incidents observed were among customers, with the remainder among staff. Overall, falling over accounted for the highest proportion (10.1%) of incidents observed and was the most commonly recorded harm in Liverpool (23.3%; $X^2$ [3] = 20.05, $p < .001$). Arguing (8.8%) was the next most common incident observed (and the most common recorded in Ljubljana and Utrecht; 13.3% and 12.1% respectively; $X^2$ [3] = 8.19, $p < .05$), followed by being so severely intoxicated that assistance was required (e.g., to walk) (5.0%).

## Table 1

*Examples of observer descriptions of incidents*

| Incident category[a] and example description |
| --- |
| **Falling over:** "A female (aged 18) was dancing provocatively around a pole (dancing pole, on a stage area) and a banister (surrounding the stage) that were on a raised dance floor/stage area. She was very drunk and fell to the floor, lying there for about 30 seconds laughing. She then got back up and carried on dancing on the pole. She had no injuries and there was no reaction from the people surrounding her (>10 people) or door staff who were standing close by." |
| **Arguing:** "Two males (aged 45 years) and two females (aged 42 and 40) were leaving the bar. One female pushed one of the males and shouted 'fuck off' at him. The door staff were watching but they laughed and did not do anything. Outside the woman said something angry at the male again. They looked like couples. Reason for argument or how it ended not known." |
| **Too intoxicated to walk without assistance:** "When we entered the venue (bar) we saw a young male (beginning of his twenties) being carried out by his friends and a member of the staff. When they arrived at the bottom of the stairs which led outside, the friends told the staff member that they would take care of him. When the staff member released the man, he immediately fell on the ground. His friends managed to get him up the stairs with great effort and put him on a bench outside. We were not able to determine whether the man sustained any injuries." |
| **Pushing or grabbing someone else in an aggressive manner:** "Four bouncers (door staff) who had been standing by the front entrance ran through the bar heading towards the toilets (reason unknown). There were only 20 people in the bar at this point. Although there was plenty of room, the bouncers ran through a group of people (three males and three females, all under 21 years) and pushed them aggressively out of their way, telling them to move! A number of drinks were dropped and smashed on the floor and drinks were spilt over the group. The group just looked amazed and shocked by what had happened. They were not that drunk." |
| **Vomiting:** "A male patron about 35–40 years old is leaning on the men's bathroom door calling at somebody inside but observer is unable to understand the words. Nobody from the staff pays attention to it. There are a lot of people moving around. Suddenly the male bends over on the closer bar counter and vomits on the floor. He stays there for a while and then leaves. Nobody from the bar (staff or patrons) has noticed anything." |

[a] List of all types of incidents of harm used in analyses: falling over; arguing; too intoxicated to walk without assistance; pushing or grabbing someone else in an aggressive manner; vomiting; threatening a person/group of people (including with a weapon); hitting someone else; a physical fight; throwing something in anger at someone; and injuring themselves.

Tables 2 and 3 show a range of recorded staffing, customer and environmental characteristics of bars, in relation to whether or not an incident was observed during a visit (additional analyses of the distribution of bar characteristics by city of visit, and the characteristics' relationship with intoxication, are provided elsewhere (Hughes et al., 2012)). Significant associations were seen between observed incidents and most customer-focused characteristics (excluding male clientele, young clientele and high-alcohol-content drinks). For staff characteristics, younger staff (more than 50% thought to be under the age of 25 years) and higher levels of permissiveness were associated with incidents. Physical characteristics associated with incidents included lower proportions of seating, higher

levels of crowdedness, the presence of glass on the floor, and toilets that had poor levels of cleanliness. Alcoholic drink promotions were associated with incidents. The playing of rock/heavy music was associated with no incidents being observed. Of the four contextual variables analyzed (city, visit time, number of customers in the premise, and whether the venue had an outdoor drinking area), only city showed an association with any incidents being observed. Logistic regression analysis was used to identify which staffing, customer and environmental characteristics of bars were independently associated with incidents being observed. Here, controlling for city and venue, in the final model only one variable remained: permissiveness (Adjusted Odds Ratio [$AOR$] = 1.5; $p < .01$).

**Table 2**

*Percentage of visits recording environmental factors, and mean ratings for environment-related scales, by whether at least one incident was observed or not*

| Variable | No incidents | Incidents observed | | |
|---|---|---|---|---|
| | %/mean | %/mean | $X^2$/f | $P$ |
| **Contextual variables** | | | | |
| Later visit | 46.8% | 62.0% | 3.65 | *ns* |
| > 100 customers | 57.4% | 68.0% | 1.83 | *ns* |
| Outdoor drinking area | 58.0% | 68.0% | 1.65 | *ns* |
| **Entry to the bar** | | | | |
| Door staff | 80.3% | 86.0% | 0.85 | *ns* |
| Queue | 21.8% | 30.0% | 1.47 | *ns* |
| Entrance fee | 20.7% | 32.0% | 2.82 | *ns* |
| House rules (entry) | 30.3% | 38.0% | 1.07 | *ns* |
| **Physical environment** | | | | |
| Seating | 5.9 | 7.1 | 7.43 | ** |
| Noise | 5.9 | 6.0 | 0.52 | *ns* |
| Crowding | 4.1 | 5.2 | 10.8 | ** |
| Ventilation | 2.9 | 3.0 | 0.03 | *ns* |
| Temperature | 4.6 | 4.8 | 0.51 | *ns* |
| Clearing | 5.1 | 5.4 | 0.50 | *ns* |
| Glass on floor | 1.7 | 3.1 | 17.13 | *** |
| Cleanliness | 4.7 | 5.2 | 2.07 | *ns* |
| Toilets | 3.7 | 4.5 | 5.18 | * |
| Lighting | 3.4 | 3.6 | 0.71 | *ns* |
| **Bar activities** | | | | |
| Dance floor | 58.0% | 70.0% | 2.39 | *ns* |
| Pool tables | 6.9% | 4.0% | 0.57 | *ns* |
| TV screens | 53.2% | 62.0% | 1.24 | *ns* |
| House rules (inside) | 29.3% | 30.0% | 0.01 | *ns* |
| Rock/heavy music | 18.6% | 6.0% | 4.69 | * |
| Rap/hip hop music | 21.8% | 28.0% | 0.85 | *ns* |
| Pop/dance music | 73.4% | 76.0% | 0.14 | *ns* |
| **Alcohol and food service** | | | | |
| Alcoholic drink promotions | 23.4% | 38.0% | 4.32 | * |
| Low drink prices | 56.9% | 44.0% | 2.65 | *ns* |
| Soft drink promotions | 16.0% | 10.0% | 1.12 | *ns* |
| Table service | 28.7% | 28.0% | 0.01 | *ns* |
| Food service | 8.5% | 4.0% | 1.15 | *ns* |

Bivariate analyses of categorical and continuous variables utilize $X^2$ and ANOVA. *ns* = not significant; *$P < .05$; **$P < .01$; ***$P < .001$.

**Table 3**

*Percentage of visits recording staffing and customer factors, and mean ratings for staffing and customer-related scales, by whether at least one incident was observed or not*

| Variable | No incidents %/mean | Incidents observed %/mean | $X^2$/f | $P$ |
|---|---|---|---|---|
| **Bar staff** | | | | |
| Fewer bar staff | 35.1% | 28.0% | 0.89 | *ns* |
| Young staff | 34.0% | 50.0% | 4.30 | * |
| Male staff | 50.5% | 58.0% | 0.88 | *ns* |
| Glass collectors | 51.6% | 62.0% | 1.72 | *ns* |
| Staff monitoring | 3.2 | 3.1 | 0.03 | *ns* |
| Staff coordination | 4.5 | 4.1 | 1.92 | *ns* |
| Staff attitude | 2.1 | 2.1 | 0.04 | *ns* |
| Staff boundaries | 2.5 | 2.2 | 0.72 | *ns* |
| Permissiveness | 1.7 | 3.0 | 25.6 | *** |
| **Customer type and behaviors** | | | | |
| Male clientele | 71.8% | 64.0% | 1.15 | *ns* |
| Young clientele | 14.4% | 22.0% | 1.72 | *ns* |
| Single sex groups | 50.0% | 66.0% | 4.06 | * |
| High alcohol drinks | 47.3% | 40.0% | 0.86 | *ns* |
| Dancing | 3.7 | 5.2 | 8.86 | ** |
| Sexual activity | 2.7 | 3.7 | 9.79 | ** |
| Sexual competition | 2.4 | 3.6 | 13.46 | *** |
| Intoxication | 3.6 | 4.6 | 13.71 | *** |
| Movement | 4.4 | 5.2 | 5.74 | * |

Bivariate analyses of categorical and continuous variables utilize $X^2$ and ANOVA. *ns* = not significant; *$P < .05$; **$P < .01$; ***$P < .001$.

# Discussion

In recent years, studies identifying the type and extent of harms experienced by young nightlife users across Europe have started to emerge (Hughes et al., 2008; 2011a; Schnitzer et al., 2010; Tutenges, 2012). While studies in Scotland (Forsyth, 2006; Forsyth, Cloonan, & Barr, 2005) have assessed the relationships between observed aggression and recorded crime within nightlife venues and individual, social and environmental factors, to our knowledge this is the first observational study to examine a range of harms within venues and their links with staffing, customer and environmental characteristics across multiple European cities. Our study shows that a fifth of all visits had at least one recorded incident of harm, with a total of 114 incidents observed in 238 visits. This equates to just under one incident observed in every two hours of observation (though some minor incidents may have gone unobserved). A larger Canadian study by Graham et al. (2004), which focused on aggression rather than any type of alcohol-related harm, reported similar levels of observed harm in study venues (just over one incident in every three hours of observation), yet a study by Forsyth et al. (2005) in Scotland, again focusing on aggression in bars, reported

much lower levels (one incident in every seven hours of observation).

The most commonly observed harms in our study venues included people falling over, arguing and being too intoxicated to walk without assistance. Although we observed venues during peak times, and included venues known to experience alcohol-related harms, few severe incidents (e.g., fighting, injuries) were observed. Although minor incidents, such as those observed here, will impact upon nightlife patrons and the nighttime environment, they may not come to the attention of authorities such as the police. However, preventing minor incidents will inevitably have an impact on avoiding, and thus reducing, more serious incidents. Further research should explore the types and severity of incidents identified and reported through different means to obtain a greater understanding of the extent and nature of harms experienced across European nightlife settings. Equally, addressing the question of whether harms are more likely to occur within venues or outside is crucial to developing and focusing future research. In a U.K study of nightlife users (Anderson, Hughes, & Bellis, 2007), more participants reported having being involved in, or witnessing, a physical fight in the streets surrounding nightlife venues than inside

venues. In fact, it has been suggested that when problems (e.g., intoxicated patrons) occur inside venues, security staff may move them outside the venue, to reduce the likelihood of the venue being associated with alcohol-related harms (Scott & Didel, 2006).

Our study found alcohol-related harms were concentrated in just under half of all study venues. As suggested by other research, certain factors within a small number of bars and nightclubs can mean that alcohol-related problems such as violence are concentrated in those premises (Briscoe & Donnelly, 2003; Newton & Hirschfield, 2009); altering these factors can reduce or increase the risks of alcohol-related harms. Similar to other research (Graham et al., 2004; 2006), our bivariate analyses identified a wide range of staffing, customer and environmental factors that were significantly associated with incidents of harm, such as glass on the venue floor, a permissive environment, and high levels of intoxication amongst patrons. Within the final logistic regression model, however, only one factor remained significant: a permissive environment. The links between a permissive environment and aggression and intoxication in nightlife venues have been identified elsewhere (Graham et al., 2006; Hughes et al., 2012). Our findings support such research and suggest that while a broad suite of measures that aim to prevent alcohol-related harm may be needed (Calafat, Duch, Juan, & Leckenby, 2012), activity should specifically focus on improving management practices and on the behavioral standards expected of customers in European nightlife venues.

Our study has some limitations. As with all cross-sectional surveys, results do not establish cause and effect. Thus, we cannot ascertain causal relationships between bar and customer characteristics and incidence of harm. However, our findings do identify characteristics that may increase the risk of incidents of harm occurring in nightlife venues, and this intelligence can inform prevention measures. Our study may also have been affected by structural and cultural inconsistencies across the four countries, such as differences in licensing legislation or in researcher interpretation of the observational measures and what constitutes harm in nightlife (despite the detailed training program the researchers received). While the use of the same researchers across all four countries would have improved the likelihood of our study being implemented consistently, this would be logistically complicated. Our study did not aim to compare the extent of harms experienced across the four countries, but the number recorded in each country varied widely, with Palma reporting the lowest levels. Further research exploring the reasons behind Palma's comparatively low levels of observed harm is needed, and may help identify ways to prevent harm within nightlife venues. Such research is particularly important given the perceived convergence of drinking patterns across Europe, particularly among young people (Anderson & Baumberg, 2006; Hibell et al., 2009; Jarvinen & Room, 2007). Further, across all countries, few incidents were recorded involving staff. Data presented in our study are based on observations made in environments that were often dark and busy; as such, field researchers may have missed some incidents, such as occurrences among staff who were out of sight (e.g., behind bar counters). Finally, while for most countries (excluding Palma) we randomly selected bars for inclusion in the study, the venues selected were not, nor were they intended to be, representative of each city. The sample was designed only to explore venues popular with young people in each city.

**Conclusion**

Our study illustrates the types of harms occurring in European nightlife settings. Few severe incidents (e.g., violence) were seen; observed harms were typically minor, such as patrons falling over, arguing, and being too drunk to walk. However, such incidents have the potential to escalate into more serious harms and will inevitably impact upon nightlife patrons, nightlife environments, and local services, such as health and criminal justice. Preventing such incidents is therefore important. With incidents of harm more likely to occur in permissive environments, prevention should focus on improving management practice, including staff expectations regarding the behavioral standards of customers.

# References

Anderson, Z., Hughes, K., & Bellis, M. A. (2007). *Exploration of young people's experience and perceptions of violence in Liverpool's nightlife*. Liverpool, UK: Centre for Public Health, Liverpool John Moores University.

Briscoe, S., & Donnelly, N. (2003). Problematic licensed premises for assault in inner Sydney, Newcastle, and Wollongong. *Australian and New Zealand Journal of Criminology*, *36*(1), 18–33.

Calafat, A., Duch, M., Juan, M., & Leckenby, N. (2012). Health and safety European standards for nightlife venues. *Adicciones*, *24*(4), 355–364.

Forsyth, A. J. M. (2006). *Assessing the relationships between late night drinks marketing and alcohol-related disorder in public space*. Glasgow, Scotland: Glasgow Caledonian University.

Forsyth, A. J. M., Cloonan, M., & Barr, J. (2005). *Factors associated with alcohol-related problems within licensed premises*. Glasgow, Scotland: Glasgow Caledonian University/ University of Glasgow.

Graham, K., Bernards, S., Osgood, D. W., & Wells, S. (2006). Bad nights or bad bars? Multilevel analysis of environmental predictors of aggression in late-night large-capacity bars and clubs. *Addiction*, *101*(11), 1569–1580.

Graham, K., Osgood, D. W., Zibrowski, E., Purcell, J., Gliksman, L., Leonard, K., . . . Toomey, T. L. (2004). The effect of the Safer Bars programme on physical aggression in bars: Results of a randomized controlled trial. *Drug and Alcohol Review*, *23*(1), 31–41.

Hesse, M., Tutenges, S., Pedersen, M. U., & Koford, P. B. (2012). An exploratory prospective study of young people's drinking during a holiday. *Nordic Studies on Alcohol and Drugs*, *29*(5), 485–496.

Homel, R., Carvolth, R., Hauritz, M., McIlwain, G., & Teague, R. (2004). Making licensed venues safer for patrons: What environmental factors should be the focus of interventions? *Drug and Alcohol Review, 23*(1), 19–29.

Homel, R., Hauritz, M., Wortley, R., McIlwain, G., & Carvolth, R. (1997). Preventing alcohol-related crime through community action: The Surfers Paradise Safety Action Project. In R. Homel, (Ed.), *Policing for prevention: Reducing crime, public intoxication and injury* (pp. 35–90). Monsey, NY, United States: Criminal Justice Press.

Hughes, K., Anderson, Z. A., Morleo, M., & Bellis, M. A. (2008). Alcohol, nightlife and violence: The relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction, 103*(1), 60–65.

Hughes, K., Furness, L., Jones, L., & Bellis, M. A. (2010). *Reducing harm in drinking environments: Evidence and practice in Europe*. Liverpool, England: Centre for Public Health, Liverpool John Moores University.

Hughes, K., Quigg, Z., Bellis, M. A., Calafat, A., van Hasselt, N., Košir, M., . . . Juan, J. (2012). Drunk and disorganised: Relationships between bar characteristics and customer intoxication in European drinking environments. *International Journal of Environmental Research and Public Health*, *9*(11), 4068–4082. doi:10.3390/ijerph9114068

Hughes, K., Quigg, Z., Bellis, M. A., van Hasselt, N., Calafat, A., Košir, M., . . . Voorham, L. (2011a). Drinking behaviours and blood alcohol concentration in four European drinking environments: A cross-sectional study. *BMC Public Health*, *11*, 918. doi:10.1186/1471-2458-11-918

Hughes, K., Quigg, Z., Eckley, L., Bellis, M. A., Jones, L., Calafat, A., . . . van Hasselt, N. (2011b). Environmental factors in drinking venues and alcohol-related harm: The evidence-base for European intervention. *Addiction*, *106*(1), 37–46. doi: 10.1111/j.1360-0443.2010.03316.x.

Luke, L. C., Dewar, C., Bailey, M., McGreevy, D., Morris, H., & Burdett-Smith, P. (2002). A little nightclub medicine: The healthcare implications of clubbing. *Emergency Medicine Journal, 19*, 542–545. doi:10.1136/emj.19.6.542

Mansdotter, A. M., Rydberg, M. K., Wallin, E., Lindholm, L. A., & Andréasson, S. (2007). A cost-effectiveness analysis of alcohol prevention targeting licensed premises. European *Journal of Public Health*, *17*(6), 618–623. doi:10.1093/eurpub/ckm017

Newton, A., & Hirschfield, A. (2009). Measuring violence in and around licensed premises: The need for a better evidence base. *Crime Prevention and Community Safety, 11*(3), 171–188. doi:10.1057/cpcs.2009.12

Schnitzer, S., Bellis, M. A., Anderson, Z., Hughes, K., Calafat, A., Juan, M., & Kokkevi, A. (2010). Nightlife violence—a gender-specific view on risk factors for violence in nightlife settings: A cross-sectional study in nine European countries. *Journal of Interpersonal Violence, 25*(6), 1094–1112.

Scott, M. S., & Didel, K. (2006). *Assaults in and around bars. 2nd Edition*. Washington, DC, United States: U.S. Department of Justice Office of Community Oriented Policing Services.

Tutenges, S. (2012). Nightlife Tourism: A mixed methods study of young tourists at an international nightlife resort. *Tourist Studies*, *12*(2), 131–150. doi:10.1177/1468797612454250

# Student drinking patterns and blood alcohol concentration on commercially organised pub crawls in the UK

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## HIGHLIGHTS

- Student drinking patterns on commercially organised pub crawls were examined.
- Drinkers are estimated to consume 16.3 median alcohol units over the entire night.
- The majority (90.9%) of drinkers had preloaded prior to joining the pub crawl.
- At interview, drinkers' median blood alcohol concentration (BAC) was 0.10%.
- High BAC was associated with drinking length, drinking rate and not eating food.

## ARTICLE INFO

## ABSTRACT

*Background:* Commercial student pub crawls are associated with high levels of alcohol consumption, and are of growing concern amongst public health and student bodies. However, little is currently known about drinking behaviours whilst participating in these events.
*Methods:* A questionnaire was implemented amongst 227 students attending commercial pub crawls across three UK events. Questions established alcohol consumption patterns up to the point of interview and throughout the remaining night out, and pub crawl experience. Breathalyser tests were used to measure breath alcohol concentration (converted to blood alcohol concentration [BAC]) at interview. Analyses used chi squared, Mann–Whitney U, Kruskal–Wallis and logistic regression.
*Results:* 94.3% of participants had consumed alcohol, 90.9% of whom reported preloading. Drinkers reported consuming a median of 10.0 alcohol units (80 g of pure alcohol) up to the point of interview (range one–40.6), with estimated total consumption over the evening exceeding 16 units (range three–70.6). Median BAC of drinkers at the time of interview was 0.10%BAC (range 0.00–0.27). High BAC (>0.08%; at interview) was associated with having not eaten food in the four hours prior (AOR 4.8, p < 0.01), time spent drinking (AOR 1.4, p < 0.01) and number of units drank per hour (AOR 1.2, p < 0.01).
*Conclusions:* Measures to prevent high levels of alcohol consumption before and during commercial pub crawls should aim to alter drinking behaviours such as preloading and rapid and excessive drinking. Organisers, local authorities, universities and students should all be involved in ensuring the effective management of pub crawls, including implementation of harm prevention measures.

## 1. Introduction

Harmful and excessive alcohol use amongst students is a major public health concern. Studies across many countries show high levels of alcohol consumption amongst student populations, with some studies showing levels higher than the general population (Dantzer, Wardle, Fuller, Pampalone, & Steptoe, 2006; Gill, 2002; Kypri, Cronin, & Wright, 2005; Pickard, Bates, Dorian, Greig, & Saint, 2003). Whilst

most studies on student alcohol consumption have been conducted in North America, research in European countries has increased in the past few decades (Wicki, Kuntsche, & Gmel, 2010), providing a greater insight into European student drinking behaviours. For example, in the UK, one study found that first year students reported consuming an average of 18.9 units (151.2 g of pure alcohol) per week (males 24.0 units, females 15.4 units: Bewick et al., 2008). Another UK study found that over half (56%) of students from one university reported binge drinking (defined as: females, 4+alcoholic drinks; males, 5+alcoholic drinks in one drinking session) at least once in the previous seven days (Dodd, Al-Nakeeb, Nevill, & Forshaw, 2010).

Whilst reported benefits of student drinking include an enhanced social life, self-confidence and fun/humour (Orford, Krishnan, Balaam,

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Everitt, & van Der Graaf, 2004), such high levels of alcohol consumption have been found to have negative impacts on student's studies, finances, and physical and mental health (Bewick et al., 2008; Dodd et al., 2010). Such harms may include: intentional (e.g. assaults) and unintentional (e.g. falls, road traffic incidents) injury; unprotected sex (increasing risks of sexual transmitted infections or unwanted pregnancy); compromised academic achievement; relationship problems; financial issues; and criminal consequences (affecting future job prospects) (Perkins, 2002; Snow, Wallace, Staiger, & Stolz-Grobusch, 2003). For example, in one UK study, 77% of students agreed that their alcohol consumption was having a negative effect on their finances, 48% on their physical health and 34% on their studies (Bewick et al., 2008). Wider impacts may also affect students through disturbed sleep or study, or damage to property or self (e.g. through assault/sexual assault) (Perkins, 2002; West, Drummond, & Eames, 1990). Further impacts on the communities in which students consume alcohol also occur through the effects of anti-social and drunken behaviour, including property damage (West et al., 1990), and pressures exerted on local health and criminal justice services (Palk, Davey, & Freeman, 2007).

Despite these harms, alcohol consumption, often to excess, can be viewed as an accepted and routine part of student life (Carpenter et al., 2007; Wicki et al., 2010). Universities themselves tend to have at least one student bar licensed to sell alcohol, typically used as a place for students to meet up, socialise and have fun. Further, many student events are focused around alcohol consumption. For example, at the beginning of the academic year 'Fresher's week' (the period in which events are held to welcome new students to the university and local community) usually includes invitations to events held in bars and nightclubs (e.g. student pub crawls; www.rush-uk.com). Equally, throughout term time, social events and student nights (established and promoted by student unions or commercial organisations), often set up within licensed premises, can play a major role in a student's university life.

In the UK, excessive student alcohol consumption is of growing concern amongst many public health partners and student bodies (Drinkaware/National Union of Students, 2011); such concerns have focused around the relatively new phenomena of mass commercial student pub crawls. These events encourage students to visit multiple drinking venues throughout an evening, promoting protracted and excessive alcohol consumption (events tend to start around 7 pm and last until the final venue, usually a large capacity bar/nightclub, closes; usually post 2 am). Despite providing business to town and city centre economies on normally quiet evenings (most pub crawls occur on week day evenings), crowds of students moving between pubs, bars and nightclubs, combined with high levels of intoxication and anti-social behaviour by participants have attracted widespread media attention (Braidwood, 2009; Dwan, 2011; Hill, 2009; Hubbard, 2011). Thus, national organisations with a vested interest in student and public safety and health (e.g. National Union for Students, police) have major concerns about commercially organised pub crawls (Braidwood, 2009). Despite such concerns, little is actually known about student drinking behaviours whilst participating in commercially organised pub crawls. Our study aimed to address this gap by examining the amount and patterns of alcohol consumption amongst students attending commercially organised pub crawls, and to measure blood alcohol concentration (BAC) amongst drinkers during their night out.

## 2. Materials and methods

### 2.1. Setting

Three commercial pub crawls organised by one company were used as study events. The pub crawls took place in two cities in the North West of England, both with a substantial student population, between October to November 2010. The events had been advertised on posters/flyers distributed amongst students and via social networking sites, with students able to register their interest in the pub crawl (and other pub crawls) via a dedicated website. Each event cost £10.00 to join payable in advance of the event, with a pub crawl t-shirt provided as receipt of payment. Participants were required to wear the t-shirt on the night of the event to gain access to participating venues (listed on the t-shirt). Each event had a theme, such as doctors and nurses. Thus, many participants were also in fancy dress; females were often scantily dressed. Participants were encouraged by stewards to write crude messages on their pub crawl t-shirt (e.g. "I want it hard up the arse"). Although event stewards (often students themselves), identified through bright coloured jackets, supervised each pub crawl (e.g. ensuring participant safety and monitoring their behaviour), events were loosely managed. Whilst some participants were chaperoned by stewards between venues, many frequently roamed freely between venues and within the streets surrounding the pub crawl. Further, some participants were observed drinking alcohol in the streets surrounding the pub crawls (despite street drinking bans being in place), and/or appeared to not be visiting the pub crawl venues, but rather use the event as an opportunity to socialise and join in the atmosphere. Each event was observed by local police.

### 2.2. Participants

Between 600 and 1,000 individuals were estimated to have attended each event. Teams of two researchers accompanied by a supervisor recruited individuals attending the pub crawls between 7 pm and 2.10 am. Researchers approached potential participants in the streets surrounding the pub crawl and asked them if they had time to complete a short anonymous survey about alcohol, followed by a breath test. The research supervisor monitored the field work and, as much as possible, ensured that researchers did not approach the same individuals more than once. Researchers also asked potential participants if they had participated in the study earlier that evening. Across all three events, no participants reported having already been approached or interviewed. Of 305 individuals approached, 61 refused to participate after the nature of the study was explained to them. Thus, 244 pub crawl participants took part in the study (80% compliance). Of these, 17 were not students and thus were removed from further analyses, leaving a sample of 227 students.

### 2.3. Procedures and measures

The questionnaire, completed through an interview process between the researcher and participant, recorded: alcohol use up to the point of interview (by type and size of beverage); estimated alcohol consumption over the remainder of the night out; when and where they started drinking; when they had eaten their last meal; whether they felt drunk; whether they had experienced any negative behaviours (e.g. vomited) up until the point of interview; the time which they expected to go home; their views and experience of the pub crawl so far (including the number of drinks consumed per bar); and basic demographics (age/gender). Following questionnaire completion, participants were breathalysed using the Lion 500 alcometer and results were recorded on their completed questionnaire. To comply with breath alcohol concentration (BrAT) requirements, the study process was designed to ensure that sufficient time had passed (20 min) for any alcohol in the participants' mouths to have absorbed prior to breath testing, and participants were requested not to smoke during interview (Lion Laboratories, 2000). Each participant was provided with their own mouthpiece, which was discarded safely once used.

### 2.4. Analyses

Completed questionnaires were entered into a database for analysis using SPSS v17. For analysis, BrAT was converted to the more commonly used blood alcohol concentration (%BAC; milligrams of alcohol per

100 ml of blood) according to established UK ratios (Her Majesty's Stationery Office, 1981). Reported alcoholic drinks consumed were converted into standard UK units (1 unit = 8 g or 10 ml of pure alcohol) using published figures for alcohol contents (e.g. single shot of spirits = 1 unit; bottle of lager = 1.5 units; standard glass of wine = 2 units [NHS Choices, 2011]). Statistical analysis used chi squared, Mann–Whitney U, Kruskal–Wallis and logistic regression.

### 2.5. Ethical approval

Ethical approval for the study was obtained from Liverpool John Moores University research ethics committee. To meet ethics requirements, researchers were instructed to visually assess potential participants and exclude those who were already too intoxicated to participate (identified through visual signs such as a staggered gait and glazed eyes). Calculating the total number of individuals excluded due to severe inebriation was not possible as no record was kept.

## 3. Results

### 3.1. Sample characteristics

Four in ten (40.1%) surveys were conducted at event A, and three in ten at event B and event C (Table 1). Overall, half (50.7%) of participants were female, with the majority (65.6%) aged 20 years and under (range 17 to 27). A third (32.6%) of participants reported being on the pub crawl with one to five people (excluding themselves), 43.0% with six to 10 people and 24.4% with more than 10 people. Pub crawls started in each event between 7 pm and 8 pm. Overall, at the time of interview, 79.7% had started the pub crawl (i.e. been to at least one pub crawl bar) and 20.3% were on their way to the pub crawl (87.0% of whom had already consumed alcohol). The proportion of participants having not yet attended the pub crawl ranged from 27.6% of those surveyed between 7.00 pm and 8.59 pm, to 11.1% between 1.00 am and 2.59 am. Of those who had already visited at least one pub crawl bar, the median number of bars visited was three. One in ten (10.3%) participants expected to go home before 2 am, 37.6% between 2 am and 3.59 am, and 52.1% after 4 am.

### 3.2. Alcohol consumption and drinking patterns

The majority (94.3%) of participants had consumed alcohol at the time of interview. Drinkers had been consuming alcohol for a median of 3.5 h. A third (33.6%) had started drinking before 7 pm (the official start of the pub crawls) and 90.9% reported having preloaded (drinking alcohol at home or a friend's home [including halls of residence]). There was no significant difference in preloading between sex and age group; differences were observed however between events (Table 1). Amongst drinkers who had visited a pub crawl bar, the median number of alcoholic drinks consumed per bar was two; only 2.9% reported having consumed non-alcoholic drinks. Overall, 37.2% of drinkers did not feel drunk at the time of interview, 47.4% felt a little bit drunk and 15.3% said that they felt drunk (Fig. 1). Feeling drunk/a little bit drunk was significantly related to pub crawl event (Table 1; p < 0.001), hours drinking (p < 0.001, Table 2), total units consumed (p < 0.001, Table 2) and %BAC (p < 0.001, Table 2). Two participants reported consuming alcohol on the streets prior to joining the pub crawl; a behaviour regularly observed by researchers at the two pub crawl events (A and C) studied in the same city.

At the time of interview, spirits were the most commonly reported drink consumed by drinkers (71.4%; many as shots). Over a third (38.8%) of drinkers reported consuming beer/lager/cider, 24.5% wine, 19.9% alcopops, 3.6% cocktails and 4.1% non-alcoholic drinks. Overall, drinkers reported consuming a median of 10.0 units of alcohol (80 g or 100 ml of pure alcohol) up to the point of interview (range one to 40.6 units). Higher levels of alcohol consumption were significantly associated with being male, preloading, feeling drunk, attendance at event A and not consuming food in the 4 h prior to interview (Table 2). Drinkers reported consuming a median of 3.1 units per hour up to the point of interview; males and participants from event C reported the highest levels of hourly alcohol consumption (Table 2). Overall, drinkers estimated that they would consume a median of six additional units over the remainder of their night out (post interview). Higher levels of estimated additional alcohol consumption were associated with being male (8 units, p < 0.05), aged over 20 (10 units, p < 0.05), attendance at event A (7 units, p < 0.05) and not feeling drunk (8 units, p < 0.001). Combining alcohol consumption prior to interview and post interview, participants' total median estimated alcohol consumption over the course of their entire night out was 16.3 units (males, 19.6 units; females, 14 units: p < 0.05) (range 3 to 70.6 units). Nearly half (49.4%) of females, and over one in four (44.6%) males, estimated that their total alcohol consumption over the course of their night out would exceed the entire UK weekly limit recommended (females, 14 units; males, 21 units).

### 3.3. Blood alcohol concentration

The median BAC of drinkers at the time of interview was 0.10%BAC (range 0.00 to 0.27). There were no significant differences by age or
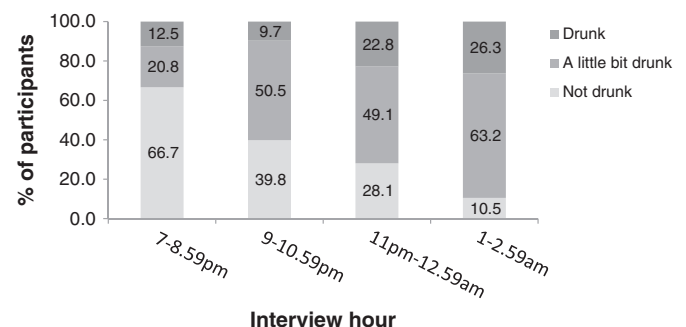
**Table 1**
Participant characteristics and alcohol consumption patterns at the point of interview.

| | Event A[a] | Event B | Event C[a] | Total | |
| | n (%) | n (%) | n (%) | n (%) | p[b] |
|---|---|---|---|---|---|
| n | 92 | 67 | 68 | 227 | |
| Under 20 | 64 (69.6%) | 47 (70.1%) | 38 (55.9%) | 149 (65.6%) | 0.129 |
| Male | 56 (60.9%) | 31 (46.3%) | 25 (36.8%) | 112 (49.3%) | <0.01 |
| Eaten in last 4 h | 8 (11.8%) | 17 (29.8%) | 31 (55.4%) | 56 (30.9%) | <0.001 |
| Consumed alcohol | 92 (100%) | 66 (98.5%) | 56 (82.4%) | 214 (94.3%) | <0.001 |
| Drinkers only: | | | | | |
| Pre-loaded | 79 (90.8%) | 56 (84.8%) | 55 (98.2%) | 190 (90.9%) | <0.05 |
| Do not feel drunk | 22 (29.7%) | 16 (24.2%) | 35 (62.5%) | 73 (37.2%) | <0.001 |
| Feel a little bit | 36 (48.6%) | 39 (59.1%) | 18 (32.1%) | 93 (47.4%) | |
| Feel drunk | 16 (21.6%) | 11 (16.7%) | 3 (5.4%) | 30 (15.3%) | |
| Median hours drinking | 4.2 | 3.5 | 2.2 | 3.5 | <0.001 |
| Median units consumed | 12.3 | 10.0 | 8.2 | 10.0 | <0.01 |

[a] Event A and C took place in the same city.
[b] Significance (p) values were obtained using chi squared and Kruskal–Wallis tests.



**Fig. 1.** Reported feelings of drunkenness at the point of interview by interview hour.

**Table 2**
Patterns of consumption and blood alcohol concentration levels of drinkers only by participant characteristics and drinking patterns, at the point of interview.

| | | Hours drinking | | Total units consumed | | Units per hour | | %BAC | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | p[a] | Median | p | Median | p | Median | p |
| Age | Under 20 | 3.4 | 0.39 | 10.0 | 0.73 | 3.0 | 0.08 | 0.10 | 0.78 |
| | 20 plus | 3.0 | | 11.2 | | 3.5 | | 0.09 | |
| Sex | Female | 3.1 | 0.06 | 8.3 | <0.01 | 2.8 | <0.01 | 0.10 | 0.14 |
| | Male | 3.6 | | 11.8 | | 3.7 | | 0.11 | |
| Event location | A | 4.2 | <0.001 | 12.4 | <0.01 | 3.0 | <0.01 | 0.13 | <0.05 |
| | B | 3.5 | | 10.0 | | 2.8 | | 0.09 | |
| | C | 2.2 | | 8.2 | | 3.9 | | 0.08 | |
| Pre-loaded | No | 2.8 | <0.05 | 7.2 | <0.05 | 2.7 | 0.17 | 0.06 | <0.01 |
| | Yes | 3.5 | | 10.6 | | 3.2 | | 0.11 | |
| Feel drunk | No | 2.3 | <0.001 | 7.8 | <0.01 | 3.4 | 0.78 | 0.06 | <0.001 |
| | A little bit | 3.5 | | 11.0 | | 3.0 | | 0.13 | |
| | Yes | 4.8 | | 16.7 | | 3.4 | | 0.14 | |
| Eaten in last 4 h | No | 4.0 | <0.001 | 12.0 | <0.001 | 3.0 | 0.38 | 0.13 | <0.001 |
| | Yes | 1.8 | | 6.8 | | 3.5 | | 0.06 | |

[a] Significance (p) values were obtained using Mann–Whitney U or Kruskal–Wallis tests.

gender. Participants who had attended event A, had preloaded, felt drunk or had not eaten in the last 4 h had significantly higher %BAC scores (Table 2). Logistic regression was used to identify demographic and drinking pattern factors independently associated with high %BAC (>0.08%). High %BAC was associated with having not eaten food in the 4 h prior to interview (AOR 4.8, p < 0.01), time spent drinking up to the point of interview (AOR 1.4, p < 0.01) and number of units drank per hour up to the point of interview (AOR 1.2, p < 0.01) (Table 3).

## 4. Discussion

Despite screening out those who were assessed as too intoxicated to participate, our study found high levels of risky single occasion drinking amongst students attending the pub crawls. At the point of interview students reported having consumed a median of 10 units, with an estimated median of 16.3 units to be consumed over the entire night out. In fact, over four in ten participants estimated that their total alcohol consumption would exceed the entire weekly limit recommended in the UK (females, 14 units; males, 21 units). At the point of interview, the median %BAC of all drinkers was 0.10%; above the UK drink driving limit (0.08%BAC; 80 mg of alcohol per 100 ml of blood). Whilst studies on weekly levels of alcohol consumption amongst UK students exist (e.g. Bewick et al., 2008), to our knowledge, there are no studies that report student alcohol consumption on a typical night out. Thus, further research would be required to determine whether reported alcohol consumption levels amongst our sample are comparable to that consumed by students on a regular night out. Similar to other research however, differences between male and female student alcohol consumption were observed (Dantzer et al., 2006; Wicki et al., 2010). Over the entire night out, the estimated total alcohol consumption amongst males was significantly highly than females. However, estimated total alcohol consumption amongst females was still high at 14 units. Whilst similar drinking levels have been found amongst females on a night out in English cities, this is not the case for males. Here, reported male student pub crawl alcohol consumption was

**Table 3**
Adjusted odds ratios (AOR) for high blood alcohol concentration (>0.08%BAC) at the point of interview.

| | AOR | 95% CIs | p |
|---|---|---|---|
| Not consumed food in the 4 h prior to interview | 4.80 | 1.8–12.5 | <0.01 |
| Hours drinking up to the point of interview | 1.40 | 1.1–1.8 | <0.01 |
| Units drank per hour up to point of interview | 1.20 | 1.1–1.5 | <0.01 |

Analysis used backward conditional logistic regression. Variables entered into the model included: age group, sex, preload, number of people on a night out with, eaten in the last 4 h, hours drinking, units drank per hour and hour of interview. CIs = Confidence Intervals.

lower that than reported amongst males generally on a night out (Bellis et al., 2010; Hughes, Anderson, Morleo, & Bellis, 2008).

With clear links between excessive student alcohol consumption and an array of negative consequences on health, studies, finances and future prospects (Bewick et al., 2008), as well as the wider community, measures are needed to reduce such high levels of alcohol use at what are widely promoted and attended events across the UK and elsewhere. Here, similar to other population and student based nightlife studies (Borsari et al., 2007; Hughes et al., 2011), our study identified preloading (i.e. consuming alcohol at home/a friend's home, including halls of residence, before a night out) as a common drinking behaviour amongst students attending organised pub crawls. In fact, compared to regular nightlife users, a much higher proportion of pub crawl participants reported this behaviour (Hughes et al., 2008, 2011). Preloading may be motivated by a need to save money (through purchasing alcohol from off-licensed premises, often cheaper than that sold in on-licensed premises) or a desire to get drunk, reducing social anxieties and enhancing the night out (Wells, Graham, & Purcell, 2009). However, other studies have shown that such behaviour is associated with a range of harms, including increased levels of alcohol consumption and higher BAC levels (Borsari et al., 2007; Hughes et al., 2008) (also shown in our bivariate analyses) and increased risk of involvement in violence whilst on a night out (Hughes et al., 2008). Commercial pub crawl organisers have a responsibility to maintain students' health and safety whilst attending their events. Whilst some organisers aim to raise awareness of the effects of excessive alcohol consumption, and may even provide free non-alcoholic drinks within pub crawl venues (Carnage, 2013), measures are clearly required to discourage preloading before event participation (e.g. informing students that those who are already severely intoxicated will not be permitted on the event/into participating venues). With many students living in university halls of residence, and thus likely to be preloading within these locations, universities have a clear role to play in developing, implementing and monitoring such measures.

Amongst our sample of pub crawl participants, many students did not follow the designated pub crawl. Whilst the events commenced between 7 pm and 8 pm, many participants surveyed after this time had not yet entered a pub crawl venue at the point of interview. Of all participants interviewed from 11 pm, 14% had not entered a pub crawl venue. Discussions with study participants suggested that the large number of pub crawl attendees and subsequent queues to enter many of the pub crawl venues meant that they sometimes visited other non-pub crawl venues in the vicinity (some of which offered cheap alcoholic drinks to students). However, this did not appear to affect their pub crawl experience. Many pub crawl participants reported that simply being amongst the crowd and joining in the atmosphere,

providing them with an opportunity to socialise, was a key part of their pub crawl participation, even if this meant socialising in the streets, or other licensed premises, surrounding designated pub crawl venues.

However, in two of the three events, researchers regularly observed on-street drinking by pub crawl participants, despite street drinking bans being in place at the time of study. Such drinking behaviours, along with preloading, should not be considered separate from the pub crawl, but rather a crucial part of the behaviours that need to be managed throughout the event by pub crawl organisers and local authorities (e.g. police) who permit and subsequently manage the impacts of organised pub crawls. Crucially, pub crawl management should not only consider those venues (and streets) that are part of the pub crawl, but also the wider impacts of the event on the surrounding night time environment, including the role of other licensed premises (trading at the same time as the pub crawl) in encouraging excessive alcohol consumption. For example, pub crawl organisers and local partners need to ensure students are aware of street drinking bans and consequences of drinking in the street in such areas, with relevant measures put in place to prevent this behaviour occurring. More broadly, the impact of preloading and street drinking on areas visited by students on their way to, between and home from the pub crawl should be assessed, with appropriate measures put in place to reduce potential impacts (e.g. ensuring that sufficient transport is available at the end of the evening to take students home/to halls of residence). Future research into student behaviours (e.g. alcohol consumption, anti-social behaviour and drink driving) prior to, during and on their way home from the pub crawl, as well as the following day (e.g. attendance at lectures), would provide further insight into the impact of such events and how they can best be managed to minimise harm.

Consistent with other research (Bellis et al., 2010), here, high %BAC levels (>0.08%BAC) were associated with having not eaten food in the 4 h prior to interview, time spent drinking and drinking rate (units drank per hour). Whilst some commercial pub crawl organisers may aim to discourage excessive alcohol consumption during events by raising awareness of the effects of alcohol and encouraging participating venues to provide free snacks and soft drinks, it is clear from our study that risky single occasion drinking is habitual, and may even be promoted (Hubbard, 2011). This is concerning, given that students are a young and vulnerable group, with most having joined university at the age of 18 (the legal drinking age in the UK and elsewhere). Further, for many, student life may be their first experience of living away from home and participating in nightlife in unfamiliar surroundings. However, avoiding excessive alcohol consumption whilst at university may be confounded by the surrounding culture that normalises drinking amongst students (Carpenter et al., 2007; Wicki et al., 2010). Research shows that perceived levels of alcohol consumption amongst students can be higher than actual consumption (Wicki et al., 2010). Given the potential impact of alcohol consumption on students' welfare and studies, universities have a crucial role to play in protecting students from harms experienced as part of their student life, including organised pub crawls. The development of effective prevention is particularly important given that a number of studies indicate continued excessive consumption amongst a subset of students throughout their studies and beyond into later life (Casswell, Pledger, & Pratap, 2002; Jennison, 2004) (others however show decreases in student drinking levels over the course of undergraduate studies (Bewick et al., 2008), or have mixed results (Wicki et al., 2010)). Altering the culture and focus of such events, and student drinking behaviours more broadly, is vital to enabling the harms associated with excessive alcohol consumption to be minimised.

Whilst many studies indicate that students typically consume alcohol for positive reasons such as pleasure or social engagement rather than to cope with stress for example (Wicki et al., 2010), a range of individual, social and environmental factors have been found to promote heavy alcohol use amongst this population. These can include being male, living alone or away from home (e.g. at halls of residence), having few family obligations, coming from a wealthier background, and having weak beliefs around the importance of limiting alcohol (Dantzer et al., 2006; Wicki et al., 2010). Whilst such risk factors can greatly inform the development and targeting of interventions aimed at reducing excessive alcohol consumption amongst students, event based factors, such as hedonistic behaviours observed and promoted at the pub crawls studied here and elsewhere in the UK (Hubbard, 2011), should also be considered.

Whilst our study shows high levels of alcohol consumption amongst students attending organised pub crawls, a study in the US, which examined alcohol use during traditional, end of semester, on campus pub crawls, found pub crawl participants were less likely than non-pub crawl participants to have a high %BAC level (>0.08%BAC; Dodd, Khey, & Maureen Miller, 2012). Differences in pub crawl style, ethos and university structures between countries may account for some of this variation. Further research looking at the differences in pub crawl type and associated student and other harms would enable a greater understanding of the best ways to organise and manage student pub crawls. At a local level, authorities, universities and student unions should share knowledge and experiences of commercial pub crawls in their towns and cities, providing information of well and poorly managed events, and the factors that contribute to this. Well established links should be made with commercial pub crawl organisers to ensure the effective management of events between all partners.

Our study faced a number of limitations common to nightlife research. Survey participants are known to underestimate quantities of alcohol consumption (Kraus et al., 2005) and those who were already severely intoxicated were excluded (Aldridge & Charles, 2008). Equally however, estimates of preloaded alcohol consumption may have been over estimated (Gill & Donaghy, 2004; Kraus et al., 2005). Our study aimed to reduce recall bias by only asking about alcohol use that day up to the point of interview and through using trained nightlife researchers who encouraged participants to be honest and comprehensive about their consumption (Aldridge & Charles, 2008). Our second measure of alcohol consumption through the use of a breathalyser test also has limitations associated with accuracy and appropriate usage (Kraus et al., 2005). Here, all breathalysers were calibrated prior to use, and researchers were provided with detailed training on their usage (e.g. ensuring at least 20 min had passed between the consumption of alcohol and the breath test being implemented). Finally, whilst the three pub crawl events were organised by one organisation and thus were similar, there may have been site-level factors that could have influenced our study (e.g. event capacity/size of nightlife area, number of non-participating venues serving alcohol in the pub crawl locality, level of police involvement, closeness to university halls of residence). Future research would benefit from the inclusion of such site level factors, along with further examination of participant behaviour on pub crawls (e.g. total number of bars visited).

## 5. Conclusion

The excessive consumption of alcohol amongst students attending commercially organised pub crawls can lead to a wide range of negative impacts on students themselves, their peers and the communities in which pub crawls occur. Effective management of these events is crucial to preventing and minimising harm. Drinking behaviours such as preloading, rapid and excessive drinking, and street drinking need to be addressed in order to reduce levels of alcohol consumption on commercially organised pub crawls. A wide range of partners have a responsibility to protect students attending such events, including organisers, police, local authorities, universities, and students themselves. All should play an active role in ensuring that commercially organised pub crawls are set up and managed in a way that minimises the risk of harm to participants and the wider community.

# References

Aldridge, J., & Charles, V. (2008). Researching the intoxicated: Informed consent implications for alcohol and drug research. *Drug and Alcohol Dependence, 93*, 191–196.

Bellis, M.A., Hughes, K., Quigg, Z., Morleo, M., Jarman, I., & Lisboa, P. (2010). Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation. *Substance Abuse Treatment, Prevention, and Policy, 5*, 5, http://dx.doi.org/10.1186/1747-597X-5-5.

Bewick, B.M., Mulhern, B., Barkham, M., Trusler, K., Hill, A. J., & Stiles, W. B. (2008). Changes in undergraduate student alcohol consumption as they progress through university. *BMC Public Health, 8*, 163, http://dx.doi.org/10.1186/1471-2458-8-163.

Borsari, B., Boyle, K. E., Hustad, J. T. P., Barnett, N.P., O'Leary Tevyaw, T., & Kahler, C. W. (2007). Drinking before drinking: Pregaming and drinking games in mandated students. *Addictive Behaviors, 32*, 2694–2705.

Braidwood, J. (2009). Student group wants ban on mass pub crawl. Sky news online. http://news.sky.com/skynews/Home/UK-News/Carnage-UK-National-Union-Of-Students-Calls-For-Ban-On-Organised-Student-Pub-Crawl/Article/200911215447117 (Accessed 29th April, 2013).

Carnage (2013). *Know Your Limits. Be safe: Stay Safe. Think Safe: Drive Safe (Online).* (www.carnageuk.com/safety/. Accessed 29th April 2013).

Carpenter, R., Fishlock, A., Mulroy, A., Oxley, B., Russell, K., Salter, C., et al. (2007). After 'Unit 1421': An exploratory study into female students' attitudes and behaviours towards binge drinking at Leeds University. *Journal of Public Health, 30*, 8–13.

Casswell, S., Pledger, M., & Pratap, S. (2002). Trajectories of drinking from 18 to 26 years: Identification and prediction. *Addiction, 97*, 1427–1437.

NHS Choices (2011). Alcohol unit calculator. www.nhs.uk/Tools/Pages/Alcohol-unit-calculator.aspx (Accessed 29th April 2013).

Dantzer, C., Wardle, J., Fuller, R., Pampalone, S. Z., & Steptoe, A. (2006). International study of heavy drinking: Attitudes and sociodemographic factors in university students. *Journal of American College Health, 55*, 83–89.

Dodd, L. J., Al-Nakeeb, Y., Nevill, A., & Forshaw, M. J. (2010). Life risk factors of students: A cluster analytical approach. *Preventive Medicine, 51*, 73–77.

Dodd, V. J., Khey, D. N., & Maureen Miller, E. (2012). Intoxication levels of bar patrons at an organised pub crawl in a college campus community. *American Journal of Criminal Justice, 37*, 246–257.

Drinkaware/National Union of Students (2011). Guidance notes for law enforcement officers: pub/bar crawls. https://resources.drinkaware.co.uk/Guidance-Notes-for-Law-Enforcement-Officers-Pub-Bar-Crawls (Accessed 29th April 2013).

Dwan, J. (2011). Five arrested during student pub crawl. Essex County Standard. http://www.essexcountystandard.co.uk/news/8910452.Five_arrested_during_student_pub_crawl/ (Accessed 29th April 2013)

Gill, J. (2002). Reported levels of alcohol consumption and binge drinking within the UK undergraduate population over the last 25 years. *Alcohol and Alcoholism, 37*, 109–120.

Gill, J. S., & Donaghy, M. (2004). Variation in the alcohol content of a 'drink' of wine and spirit poured by a sample of the Scottish population. *Health Education Research, 19*, 485–491.

Her Majesty's Stationery Office (1981). *Transport Act 1981.* (London).

Hill, A. (2009). Student pub crawls face ban amid backlash over drunken disorder. The Observer online. http://www.guardian.co.uk/education/2009/nov/08/philip-laing-carnage-binge-drinking (Accessed 29th April 2013).

Hubbard, P. (2011). Carnage! Coming to a town near you? Nightlife, uncivilised behaviour and the carnivalesque body. *Leisure Studies*, http://dx.doi.org/10.1080/02614367.2011.633616.

Hughes, K., Anderson, Z., Morleo, M., & Bellis, M.A. (2008). Alcohol, nightlife and violence: The relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction, 103*, 60–65.

Hughes, K., Quigg, Z., Bellis, M.A., van Hasselt, N., Calafat, A., Kosir, M., et al. (2011). Drinking behaviours and blood alcohol concentration in four European drinking environments: A cross-sectional study. *BMC Public Health, 11*, 918.

Jennison, K. M. (2004). The short-term effects and unintended long-term consequences of binge drinking in college: A 10-year follow-up study. *The American Journal of Drug and Alcohol Abuse, 30*, 659–684.

Kraus, C. L., Salazar, N. C., Mitchell, R., Florin, W. D., Guenther, B., Brady, D., et al. (2005). Inconsistencies between actual and estimated blood alcohol concentrations in a field study of college students: Do students really know how much they drink? *Alcoholism, Clinical and Experimental Research, 29*, 1672–1676.

Kypri, K., Cronin, M., & Wright, C. S. (2005). Do University students drink more hazardously than their non-student peers? *Addiction, 100*, 713–714.

Lion Laboratories Ltd (2000). *Alcohol in the Human Body.* (Barry).

Orford, J., Krishnan, M., Balaam, M., Everitt, M., & van Der Graaf, K. (2004). University student drinking: The role of motivational and social factors. *Drugs: Education, Prevention and Policy, 11*, 407–421.

Palk, G., Davey, J., & Freeman, J. (2007). Policing alcohol-related incidents: A study of time and prevalence. *Policing, 30*, 82–92.

Perkins, H. W. (2002). Surveying the damage: A review of research on consequences of alcohol misuse in college populations. *Journal of Studies on Alcohol, 14*, 91–100.

Pickard, M., Bates, L., Dorian, M., Greig, H., & Saint, D. (2003). Alcohol and drug use in second-year medical student at the University of Leeds. *Medical Education, 34*, 148–150.

Snow, P., Wallace, S., Staiger, P., & Stolz-Grobusch, B. (2003). "As long as it doesn't spill over into class": Harm arising from students' alcohol use, and the role of policy in reducing them. *The International Journal on Drug Policy, 14*, 5–16.

Wells, S., Graham, K., & Purcell, J. (2009). Policy implications of the widespread practice of 'pre-drinking' or 'pre-gaming' before going to public drinking establishments: Are current prevention strategies backfiring? *Addiction, 104*, 4–9.

West, R., Drummond, C., & Eames, K. (1990). Alcohol consumption, problem drinking and anti-social behaviour in a sample of college students. *British Journal of Addiction, 85*, 479–486.

Wicki, M., Kuntsche, E., & Gmel, G. (2010). Drinking at European universities? A review of students' alcohol use. *Addictive Behaviors, 35*, 913–924.

# Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms

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## ABSTRACT

**Objective** To examine emergency department (ED) data sharing via a local injury surveillance system and assess its contribution to the prevention of violence and alcohol-related harms.

**Methods** 6-year (2004—2010) exploratory study analysing injury attendances to one ED in the North West of England using descriptive and trend analyses.

**Results** Over the 6-year period, there were 242 796 ED injury attendances, including 21 683 for intentional injuries. Compared with unintentional injury patients, intentional injury patients were more likely to be men, aged 18—34 years, live in the most deprived communities, have attended the ED at night/weekends, have been injured in a public place and have consumed alcohol prior to the injury. Detailed data collected on alcohol and violence-related ED attendances were shared with local partners to monitor local trends and inform prevention activity including targeted policing and licensing enforcement. Over the 6-year period, intentional ED injury attendances decreased by 35.6% and alcohol-related assault attendances decreased by 30.3%.

**Conclusions** The collection of additional ED data on assault details and alcohol use prior to injury, and its integration into multi-agency policy and practice, played an important role in driving local violence prevention activity. Further research is needed to assess the direct contribution ED data sharing makes to reductions in violence.

## INTRODUCTION

The WHO promotes the sharing and use of emergency department (ED) data as a major component in the public health approach to prevent injuries.[1—3] Routine recording of attendance cause and patient demographics means ED data can be used to monitor injuries, identify 'at risk groups and communities' for targeting appropriate prevention activity and evaluate its impacts. Injury surveillance systems (ISSs) using data captured in EDs have been successfully established in both high and middle income countries.[4—9] However, in many countries the use of ED data for injury prevention remains underdeveloped.[8 10]

In the UK, a range of ED-based ISSs have been established to inform injury prevention. With some exceptions (eg, All Wales ISS[11]), most have focused on specific injury types,[12] injury severity[13] or age groups.[14] In England, a national commissioning dataset (NCD)[15] has been established that requires all EDs to collect a standard set of data on

individual attendances, including injury group and location, patient demographics, attendance time and date, and arrival, referral and disposal method. These data were first published in 2009 and are updated annually. However, data are currently incomplete, of poor quality and not available at a suitable level for use in local injury prevention work.[16] There is growing recognition across the UK of the utility of ED data in injury prevention. In particular, the government is promoting the collection of detailed data on violence and its sharing with police and other agencies to target violence prevention.[17] In 2009, the College of Emergency Medicine published guidelines for EDs to support information sharing to reduce violence.[18] Despite the increasing support for ED data sharing, local partners have struggled to access data.[19] Factors including variations in data collection methods and information systems between EDs, poor understanding of what can be shared while maintaining patient confidentiality and a lack of incentives for health services to share data have hampered data sharing.[19 20]

In 2002, the Trauma and Injury Intelligence Group (TIIG) multi-agency ISS (box 1) was established to improve the availability and use of injury data in the English county of Merseyside, with a particular focus on ED data. Since its inception, TIIG has expanded to cover all 31 EDs (across 39 local authority areas) in the North West of England. TIIG offers a comprehensive ED ISS that covers all injury types, all population groups and operates flexibly to meet the needs of local partners. In this article, we describe the establishment of TIIG in Wirral local authority area. Wirral's single ED (Arrowe Park Hospital, Wirral NHS Trust) was one of the first to join the TIIG ISS and has consistently provided data since 2003/2004. The geographical location of the ED on the Wirral peninsula means that the majority of attendees (89.9% in 2009/2010) are residents of Wirral local authority, which includes some of the most and least deprived communities in England.[23] Continued ED data collection and sharing has provided partners with information to develop, target and implement injury prevention activities. In this study, we analyse ED data to identify the nature of injury presentations and trends in intentional and unintentional injury presentations over a 6-year period. We then assess the contribution of ED data sharing to local violence and alcohol-related harm prevention activity.

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### Box 1 The Trauma and Injury Intelligence Group (TIIG)

TIIG was established in a county in the North West of England in 2001. The remit of the group (including representatives from health, criminal justice, the fire service and academia) was to establish the burden of injuries among the local population, recommend evidenced-based interventions to prevent injury and support the local implementation of such initiatives. A review of injury data sources indicated a lack of locally available data.[21] Consequently, in 2002, TIIG secured funding to develop a population-based injury surveillance system (ISS). The funding enabled the employment of a dedicated TIIG officer to develop and manage the ISS, based at Liverpool John Moores University. Partners who were collecting electronic injury data on a routine basis were asked, and agreed to participate in the ISS. These included six emergency departments (EDs), the fire service and ambulance service. Data sharing and dissemination protocols were established and signed.[22] In addition, hospital episodes and mortality data were accessed from pre-existing injury data sources (ie, North West Public Health Observatory; http://www.nwpho.org.uk). Data needs, reporting styles and schedules were determined through discussion with local partners. Reports have included monthly reports covering all ED injury attendances, more detailed reports on alcohol and violence (eg, bi-weekly reports for police) and annual reports on key injury issues, including childhood injuries, falls and violence. Since 2003/2004, partners have also made more than 100 requests for ad hoc data analyses via the TIIG website (http://www.tiig.info) to support specific interventions.

### METHODS

ED data sharing was established through a series of meetings between the TIIG and ED personnel including the ED manager, information manager and data confidentiality lead (Caldicott guardian[24]). Discussions focused on data sharing legislation, patient confidentiality, data availability/usage, the implications of involvement for ED practice and how additional demands on staff could be minimised. Data sharing protocols were established allowing pseudo-anonymised (eg, age opposed to date of birth) data to be shared with TIIG on a monthly basis via secure email. Initial data sharing commenced in 2002 and included data fields from the NCD[15] and other injury-related data items already collected by the ED (including categories of injury types not recorded through the NCD). Data covered all ED patients entered onto their electronic patient administration system, and included data collected through a series of routine questions asked during the booking in process (by receptionists), at triage (by nurses) and during treatment and discharge (by consultants).

Consultation with local partners (eg, public health professionals, police) identified violence, alcohol-related injuries and injuries in the home as key prevention priorities. Thus, the hospital removed fields that were not being used for administrative, clinical or strategic purposes, and added data items (in 2003/2004) to support local priorities. These were for collection by ED receptionists and included: for all attendances, whether alcohol had been consumed in the 3 h preceding the incident; and for assault patients, the location of assault and number of attackers. Reception staff training for collecting the additional data and improving overall data collection quality was provided by the TIIG officer, based at Liverpool John Moores University.

Data quality was monitored by the ED data quality officer. Full data sharing commenced in 2003/2004, with the TIIG officer cleaning and analysing the data and providing routine reports, themed injury analyses and ad hoc data requests to partners. All partners accessing data throughout the 6 years were asked to provide details of how they intended to use the data, its purpose and the perceived impact of data usage. In addition, local partners provided verbal feedback to the ED and the TIIG staff in ED staff meetings. Further information on data usage was obtained through partner surveys, which aimed to assess data accessibility, usage and forthcoming injury prevention priorities.

For this study, ED data covering six financial years (April 2004—March 2010) were extracted from the TIIG ISS. Variables included in the analyses were age, sex, injury group, incident location, attendance time/date, whether the patient had consumed alcohol within 3 h preceding the incident and disposal method. Injuries were categorised into intentional (ie, violence and self-harm) and unintentional. In order to assign individuals with a measure of deprivation, their postcode of residence was mapped to a lower super output area (a geographical area (population mean=1500) used to standardise reporting of small area statistics in England and Wales)[25] and linked to the Index of Multiple Deprivation 2007 (a composite measure of deprivation combining economic, social and housing data[23]). Analyses examined trends in ED attendances for intentional and unintentional injury using descriptive statistics and $\chi^2$ tests (including $\chi^2$ for a trend). Data were analysed using SPSS V.17.

### RESULTS

Over the 6 years there were 242 796 ED injury attendances (accounting for 44.5% of all attendances). Most injury groups shared with TIIG are not recorded in the NCD (table 1). For example, falls are not recorded as a separate injury category in

**Table 1** Incident type of emergency department attendances by the NCD and TIIG recoded dataset, 2009/2010

| Injury category | Incident type | NCD | TIIG dataset |
|---|---|---|---|
| Intentional | Assault | 2035 | 2035 |
| | Firearm | — | 2 |
| | Deliberate self-harm | 662 | 662 |
| Unintentional | Road traffic collision | 3497 | 3497 |
| | Sports injury | 1354 | 1354 |
| | Fall | — | 15 910 |
| | Struck (blunt object) | — | 4926 |
| | Wound/cut | — | 2649 |
| | Burn/scold | — | 367 |
| | Bite | — | 378 |
| | Ingestion | — | 338 |
| | Inhalation | — | 56 |
| | Non-fire burn/scold | — | 43 |
| | Electrical | — | 14 |
| | Drown/immersion | — | 11 |
| | Other injury (including fireworks) | 15 275 | 3455 |
| Total injury attendances | | 22 823 | 35 697 |
| Other attendances (eg, surgical/medical problem) | | 66 865 | 53 991 |
| Total attendances | | 89 688 | |

The emergency department collects additional data on injury type (eg, fall/burn) in a separate field to the NCD injury group field. Here, data collection methods mean that an attendance can be recorded as 'other injury' within the NCD injury grouping yet still be identified as a fall- or burn-related injury, for example, in the addition field. TIIG combine fields to provide partners with the most detailed and useful data on injury type, with each attendee categorised into one injury group.
NCD, national commissioning dataset; TIIG, Trauma and Injury Intelligence Group.

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the NCD, instead mostly being coded as 'other injury' or 'medical' attendances; the TIIG dataset identified 15 910 fall-related ED attendances in 2009/2010, accounting for 17.7% of all attendances and 44.6% of injury attendances. Overall, the TIIG identified 12 874 more injury attendances in 2009/2010 than the NCD. Further, 66.9% of injury attendances recorded through the NCD were categorised as 'other injury', accounting for one in five (17.0%) ED attendances. In comparison, 9.6% of the injury attendances recorded through TIIG were recorded as 'other injury', accounting for 3.8% of all ED attendances.

Table 2 shows the demography and circumstances of ED injury attendances by year. Across the 6 years, the majority (91.1%) of presentations were for unintentional injuries (eg, 44.9% fall-related, 15.8% struck by an object, 10.4% road traffic collision). Assaults accounted for 70.2% of intentional injury attendances and deliberate self-harm 29.6%; <1% were recorded as gunshot wounds or stabbings. There were significant demographic (ie, age, gender, area of residence) and circumstantial (ie, injury location, attendance time/date) differences between unintentional and intentional injury patients. For example, compared with unintentional injury, intentional injury attendees were more likely to be men (62.0%), aged 18–34 years (41.3%), live in the most deprived communities (58.8%), have been injured in a public place (58.3%) and have consumed alcohol within 3 h prior to injury (47.2%). Further, they were more likely to attend the ED at night (18:00–05:59: 63.7% cf. 34.0%; p<0.001) and at weekends (Friday–Sunday: 53.6% cf. 41.6%; p<0.001). Compared with unintentional injury attendances, a higher proportion of intentional injury attendances were admitted into hospital for further treatment/monitoring (32.2% cf. 10.7%; p<0.001).

Over the 6 years, the majority (96.4%) of injury attendees were asked if they had consumed alcohol within 3 h prior to their injury. Nearly half (47.2%) of intentional injury and 4.9% of unintentional injury patients reported drinking alcohol (p<0.001). One-third (33.0%) of alcohol-related injury attendances were recorded as an assault, 27.9% a fall and 15.6% deliberate self-harm. Alcohol-related ED attendees were more likely (p<0.001) to be men, aged 18–34 years, reside in the most deprived communities and attend the ED at night/weekends. Patients who reported having consumed alcohol prior to injury were more likely to be admitted to hospital than those who had not consumed alcohol (intentional injury: 37.5% cf. 19.7%, p<0.001; unintentional injury: 24.0% cf. 9.6%, p<0.001).

$\chi^2$ for a trend analyses showed significant decreases in both intentional (35.6%; p<0.001) and unintentional (11.5%; p<0.001) injury attendances. For unintentional injuries, decreases were seen in all age groups except the 0–4 years and 65+ years age groups. For intentional injuries, all age groups decreased with the largest decreases seen in the 5–17 years (49.1%) and 65+ years (43.5%) age groups. The proportion of intentional injury attendances that were admitted to hospital decreased (5.3%; p<0.001), while the proportion of unintentional injury attendances that were admitted increased (1.3%; p<0.001). There were decreases in alcohol-related injury attendances (assaults, 30.3%; falls, 23.4%; deliberate self-harm, 56.9%). There was a decrease in the number of falls recorded as alcohol-related, compared with non alcohol-related falls (23.4% cf. 0.8%; p<0.001).

## DISCUSSION

This study has described the establishment of ED data sharing in a local municipality in the UK, as part of the development of a broader ISS. Injury surveillance is widely recognised to be

**Table 2** Emergency department attendances for intentional and unintentional injury by patient demographics, incident location, hospital admittance and deprivation, 2004/2005 to 2009/2010

| Injury type | Intentional | | | | | | Unintentional | | | | | | 2004–2010 | | χ² | p Value between injury types |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2004/2005 | 2005/2006 | 2006/2007 | 2007/2008 | 2008/2009 | 2009/2010 | 2004/2005 | 2005/2006 | 2006/2007 | 2007/2008 | 2008/2009 | 2009/2010 | Intentional | Unintentional | | |
| Total attendances | 4188 | 4206 | 4005 | 3518 | 3068 | 2698 | 37 276 | 37 390 | 37 776 | 39 628 | 36 047 | 32 996 | 21 683 | 221 113 | 399 | <0.001 |
| % of ED attendances | 4.9 | 4.6 | 4.3 | 3.8 | 3.3 | 3.0 | 43.8 | 41.1 | 40.6 | 42.3 | 38.3 | 36.8 | 4.0 | 40.5 | | |
| % Men | 63.3 | 60.6 | 61.4 | 60.8 | 62.3 | 64.6 | 56.1 | 55.4 | 55.6 | 54.7 | 54.8 | 53.7 | 62.0 | 55.1 | | |
| Age group (%) | | | | | | | | | | | | | | | | |
| 0–4 years | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.1 | 7.6 | 7.2 | 8.1 | 8.8 | 9.3 | 6.2 | 0.1 | 8.3 | 9731 | <0.001 |
| 5–17 years | 16.9 | 16.5 | 18.1 | 15.3 | 14.5 | 13.3 | 24.8 | 25.5 | 24.4 | 24.7 | 24.4 | 22.2 | 16.0 | 24.4 | | |
| 18–34 years | 37.8 | 40.2 | 40.4 | 42.9 | 44.0 | 44.4 | 19.7 | 19.6 | 19.9 | 19.7 | 18.9 | 18.8 | 41.3 | 19.5 | | |
| 35–64 years | 43.7 | 41.8 | 39.9 | 40.5 | 40.0 | 40.8 | 33.8 | 33.8 | 33.4 | 32.0 | 31.9 | 33.1 | 41.2 | 33.0 | | |
| 65+ years | 1.5 | 1.4 | 1.5 | 1.2 | 1.3 | 1.3 | 14.2 | 13.9 | 14.2 | 14.8 | 15.5 | 16.6 | 1.4 | 14.8 | | |
| Location (%) | | | | | | | | | | | | | | | | |
| Home | 14.3 | 13.6 | 14.8 | 20.4 | 14 | 11.6 | 27.7 | 27.8 | 26.4 | 29 | 25.7 | 24.3 | 14.8 | 26.9 | 7688 | <0.001 |
| Other | 29.8 | 31.7 | 24.2 | 22.1 | 27.7 | 24.1 | 37.9 | 37.3 | 34.6 | 36.4 | 38.9 | 37.5 | 26.8 | 37.1 | | |
| Public place | 55.9 | 54.8 | 61 | 57.6 | 58.3 | 64.3 | 34.4 | 34.9 | 39 | 34.6 | 35.4 | 38.2 | 58.3 | 36 | | |
| Admitted to hospital (%) | 32.5 | 33.9 | 33.5 | 34.3 | 30.1 | 27.2 | 10.5 | 10.0 | 10.5 | 10.9 | 11.0 | 11.8 | 32.2 | 10.7 | 8250 | <0.001 |
| Live in most deprived area (%) | 57.0 | 58.0 | 60.3 | 59.4 | 59.8 | 59.3 | 38.1 | 38.6 | 38.1 | 38.9 | 38.2 | 37.8 | 58.8 | 38.3 | 3669 | <0.001 |
| Alcohol consumed (%) | | | | | | | | | | | | | | | | |
| Yes | 51.7 | 50.7 | 46.3 | 41.2 | 42.8 | 48.4 | 6.0 | 5.4 | 4.2 | 4.1 | 4.3 | 5.5 | 47.2 | 4.9 | 52 502 | <0.001 |
| No | 35.5 | 36.3 | 42.5 | 47.3 | 40.3 | 38.7 | 91.8 | 92.5 | 94.7 | 94.9 | 87.5 | 92.5 | 39.9 | 92.4 | | |
| Unknown | 12.8 | 13.0 | 11.2 | 11.5 | 17.0 | 12.9 | 2.1 | 2.1 | 1.1 | 1.0 | 8.2 | 2.0 | 12.9 | 2.7 | | |

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a critical part of effective injury prevention,[1 3 10 26] and the collection and sharing of local ED data can enable the identification of the burden of injuries in a given area, their nature and those groups most at risk.[1 9 10] For example, the TIIG ISS identified that one-fifth of all ED attendances were fall-related, which are recorded as 'other injury' in the national ED data recording system. Yet ED data have some inherent flaws. They are rarely population based and can be biased by factors including site location.[27] Further, the consistency of data collection for surveillance purposes can vary. In our study, for instance, consistency in the collection of alcohol consumption data from injury patients varied over time, although regular staff training and feedback on data usage resulted in information being collected for over 80% of all injury patients each year. Further, patients may not disclose the cause of their injury, resulting in under-recording of some injury types. For example, one study found that many victims of domestic violence would not report violence as the cause of their injury, while others would only report their abuse if asked directly, preferably by a physician.[28] Despite these issues, our study has shown that ED data sharing can be achieved and barriers to accessing and utilising local data can be overcome.[10 19]

Overall, analyses of ED data show there have been reductions in both intentional and unintentional injury attendances over the 6 years. Intentional injury presentations to the ED decreased by 35.6% and unintentional injuries by 11.5%. A significant decrease was also seen in the proportion of intentional (but not unintentional) injury attendances admitted to hospital for further treatment, potentially suggesting a decrease in the severity of assaults occurring in the municipality. The major driver for ED data sharing across this municipality (and across England) has been the prevention of violence and alcohol-related harms, and this may help explain the greater reductions seen in intentional injuries compared with unintentional injuries. Although it is not possible to attribute reductions in violence to ED data sharing, the data have been used by a range of agencies to target prevention work (see figure 1), and we can identify the role that data sharing played in focusing multi-agency resources towards violence and alcohol-related harm reduction and in monitoring their impacts.

ED data have been used to inform the development of local multi-agency strategies for preventing violence and alcohol-related harm across the municipality[29 30]; set a community safety target to reduce alcohol-related ED assault attendances by 15% (2004/2005−2007/2008); and develop, target and evaluate activities (figure 2).[31] To facilitate data usage, bi-monthly multi-agency meetings (including TIIG, health and community safety leads) have been held during which data and interventions were discussed. Prevention activities have included enforcement work targeted at drinking establishments identified as the locations of assaults resulting in ED treatment. Such enforcement has included police and licensing officer venue visits to check compliance with UK licensing laws and provide support in preventing violence and alcohol-related harm within and around the venue. In 2007/2008, data on glass-related injury attendances were used to encourage licensed premises to use polycarbonate (plastic) glassware during peak times for violence. During 2007/2008, the ED recorded eight glass-related incidents, compared with 22 in 2006/2007. Between 2004/2005 and 2007/2008, the number of ED attendances due to alcohol-related assault declined beyond the target 15% and have decreased by 34.3% since TIIG data sharing commenced (assault data from 59 EDs in England and Wales also show reductions although to a much lesser extent[12]). The success has largely been facilitated by strong partnership working between agencies and a commitment to use an evidenced-based approach to prevention.

It is widely acknowledged that many incidents of violence are not reported to police, yet those that result in injury can often require health treatment through an ED.[9 32] In Wirral (2009/2010), the police were not aware of 25% of ED reported assault incidents. In England, increasing concerns about serious youth violence have led the government to prioritise and now mandate the collection and sharing of additional ED data on violence (ie, assault location, time and weapon[17 18]). As shown in Wirral, and other areas across England and Wales,[33 34] ED data can support the targeting of interventions in areas and drinking premises where violence occurs. Florence et al[34] found that the use of ED data to inform targeted policing contributed to a reduction in violence-related hospital admissions, yet an increase in minor assaults reported by police. Our experience has identified



**Figure 1** Examples of TIIG data sharing pathways and local partner data usage. ISS, injury surveillance system; TIIG, Trauma and Injury Intelligence Group.
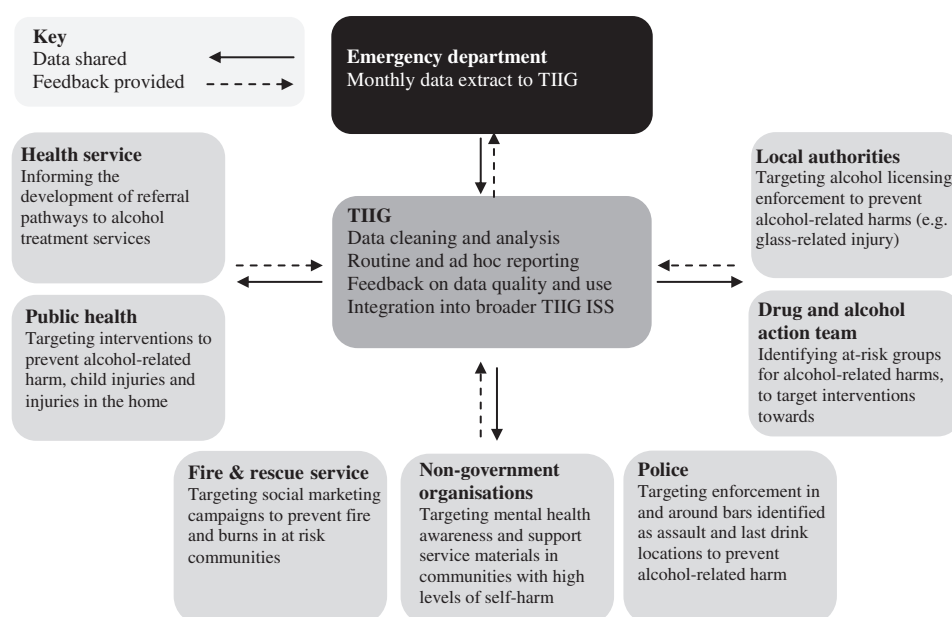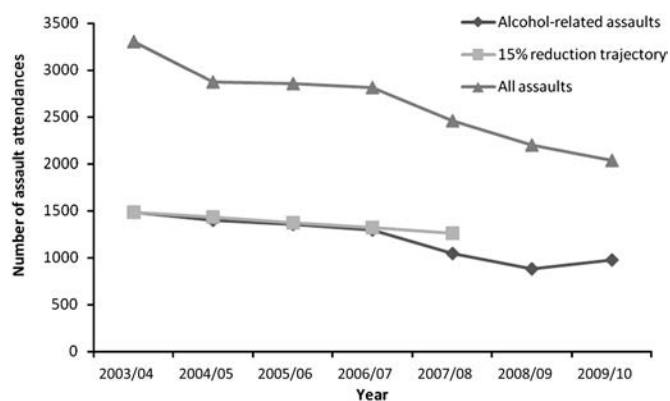
**Figure 2** Emergency department attendances for assaults, alcohol-related assaults and community safety target reduction trajectory, by year.

**What is already known on the subject**

► Emergency department (ED) data can play a key role in developing a public health approach to injury prevention.
► The sharing of enhanced ED data to inform local violence prevention is a major government priority in the UK and elsewhere, yet many areas struggle to establish such data sharing.
► Key barriers to collecting and sharing ED data for use in injury prevention include a lack of understanding of what data can be shared and constraints with information technology.

a number of elements that have facilitated ED data sharing and use that are likely to be transferable to other parts of the UK and also internationally.[8 10] These include gaining support for data sharing among all ED staff (including administrative/information technology staff who collect/manage the data); forging partnerships between EDs and injury prevention partners; developing data sharing protocols; linking additional data items to existing electronic ED systems; ensuring routine data usage by local partners; and providing ED staff with feedback on how their data are used in practice, the results this achieves and data quality.

Limiting ED data sharing to the location of assault focuses resources on policing and enforcement in areas where assaults occur. TIIG data identify strong links between assaults and deprivation, showing that while violence peaks in town and city centres at weekend nights the majority of assault patients live in the most deprived communities. Emergency hospital admissions for violence in England also show strong relationships with deprivation, with those from the most deprived communities being over five times more likely to require admission for assault than those from the least deprived communities.[35] Here, the greatest rate ratios between the least and most deprived areas are seen in childhood and later adulthood. Thus, while targeting police resources in nightlife environments can reduce violence occurring in such locations, the tendencies that lead to violence in young adults are likely established far earlier in life as they grow up in violent communities. ED data on assault victims' area of residence should be used alongside that of the location of assault to implement broader violence prevention strategies.

This is one of the first studies in the UK to examine the role of ED data sharing in violence prevention.[33 34] Our findings support associations between data sharing and reductions in violence identified by Florence *et al*.[34] However, whether data sharing is a critical component in a multi-agency response to tackling violence or symbolic of strong multi-agency responses being in place has yet to be established. With ED data sharing now being promoted, initiated and implemented at various levels throughout the UK, the current heterogeneity of approaches is likely to provide sufficient variation for a broad ecological analysis of factors associated with reductions in violence. Elsewhere, a prospective approach to identifying any causal relationships between data sharing and violence prevention could use a study design where similar areas without data sharing are matched, and data sharing is deliberately introduced into one set of cases for comparison with control areas. Such studies would need to take into account a variety of factors

**What this study adds**

► We identify how an effective ED data sharing system has been established as part of a comprehensive injury surveillance system.
► Reductions in violence were seen over the 6-year period which included the systematic integration of ED data on violence (including alcohol involvement and the nature of assault) into local violence prevention planning, activity and monitoring.
► The identification of associations between ED data sharing, multi-agency prevention activity and violence reduction support the need for more robust research to measure the specific role of ED data in violence prevention.

including socio-demographics, alcohol outlets density and approaches to violence prevention being implemented locally.

**CONCLUSION**

The establishment and use of the TIIG ISS in one municipality in England demonstrates that comprehensive data collection and sharing between EDs and multi-agency partnerships can be achieved and sustained, and can play a key role in supporting injury prevention. Focusing on intentional injuries, our study has demonstrated how additional ED data collection on alcohol and violence-related attendances, and the development of a multi-agency partnership to promote the use of ED data at a local level, has supported targeted interventions, such as policing and licensing enforcement. ED data provide vital intelligence on patient demographics that could also usefully inform broader violence prevention work towards individuals and communities most at risk. While this study shows significant reductions in intentional and alcohol-related assault attendances to the ED, further research is required to identify the specific contribution of data sharing to violence prevention.

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**Contributors** ZQ analysed the data and produced the manuscript. KH and MAB assisted in the production of the manuscript. All authors read and reviewed the final manuscript.

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**Data sharing statement** The emergency department data were obtained from Wirral NHS Trust. All data shared were depersonalised and conform to the UK Data Protection Act 1998 and relevant government data sharing guidelines.

## REFERENCES

1. **Holder Y,** Peden M, Krug E, et al. Injury Surveillance Guidelines. Geneva: World Health Organisation, 2001.
2. **Butchart A,** Brown D, Khanh-huynh A, et al. Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence. Geneva: World Health Organisation and Department of Health and Human Services, Centers for Disease Control and Prevention, 2008.
3. **Peden M,** Scurfield R, Sleet D, et al. World Report on Road Traffic Injury Prevention. Geneva: World Health Organisation, 2004.
4. **Mackenzie SG,** Barry Pless I. CHIRPP: Canada's principal injury surveillance program. Inj Prev 1999;**5**:208—13.
5. **Quinlan KP,** Thompson MP, Annest JL, et al. Expanding the National Electronic Injury Surveillance System to monitor all nonfatal injuries treated in US hospital emergency departments. Annals Emerg Med 1999;**34**:637—45.
6. **Zuckerbraun NS,** Powell EC, Sheehan KM, et al. Community childhood injury surveillance: an emergency department-based model. Pediatr Emerg Care 2004;**20**:361—6.
7. **Sanchez CA,** Thomas KE, Malilay J, et al. Nonfatal natural and environmental injuries treated in emergency departments, United States, 2001-2004. Fam Community Health 2010;**33**:3—10.
8. **Espitia-Hardeman V,** Borse NN, Dellinger AM, et al. The burden of childhood injuries and evidence based strategies developed using the injury surveillance system in Pasto, Colombia. Inj Prev 2011;**17**:i38—44.
9. **Faergemann C,** Lauritsen JM, Brink O, et al. Trends in deliberate interpersonal violence in the Odense Municipality, Denmark 1991—2002. The Odense study on deliberate interpersonal violence. J Forensic Leg Med 2007;**14**:20—6.
10. **Nilson P,** Bourne M, Coggan C. Using local injury surveillance for community-based injury prevention: an analysis of Scandinavian WHO safe community and Canadian safe community foundation programmes. Int J Inj Control Safe Promot 2007;**14**:35—43.
11. **Collaboration for Accident Prevention and Injury Control (CAPIC).** Accident and Emergency Department Data: All Wales Injury Surveillance Systems (AWISS). http://www.capic.org.uk/ (accessed 1 Feb 2011).
12. **Sivarajasingam V,** Wells JP, Moore S, et al. Violence in England and Wales in 2010. An Accident and Emergency Perspective. Cardiff: Cardiff University, 2008.
13. Trauma Audit Research Network (TARN). https://www.tarn.ac.uk (accessed 1 Jul 11).
14. **Shipton D,** Stone DH. The Yorkhill CHIRPP story: a qualitative evaluation of 10 years of injury surveillance at a Scottish children's hospital. Inj Prev 2008;**14**:245—9.
15. **Connecting for Health.** Commissioning Dataset Overview. http://www.datadictionary.nhs.uk/web_site_content/navigation/commissioning_data_sets_menu.asp (accessed 1 Oct 2010).
16. **Health and Social Care Information Centre.** Accident and Emergency Attendances in England (Experimental Statistics) 2008-09. London: The NHS Information Centre, 2010.
17. **HM Government.** The Coalition: Our Programme for Action. London: Cabinet Office, 2010.
18. **Boyle A,** Shepherd J, Sheehan D. Guideline for Information Sharing to Reduce Community Violence. London: College of Emergency Medicine, 2009.
19. **Davidson T,** van Staden L, Nicholas S, et al. Process Evaluation of Data Sharing between Emergency Departments and Community Safety Partnerships in the South East. London, Home Office, 2010.
20. **Boyle A,** Snelling K. Information sharing to reduce community violence: culture shift and incentives are needed. BMJ 2011;**343**:d4452.
21. **Fell R,** Tocque K, Hockey G, et al. Accident, Injury and Trauma Information and Intelligence Initiatives in Merseyside, the North West and Nationwide. Liverpool: North West Public Health Observatory, Centre for Public Health, Liverpool John Moores University, 2002.
22. **Trauma and Injury Intelligence Group.** Information Sharing Protocol Governing the Exchange of Data for the Trauma and Injury Intelligence Group. Liverpool: Centre for Public Health, John Moores University, 2010.
23. **HM Government.** Indices of Deprivation 2007 for Super Output Areas. http://data.gov.uk/dataset/index_of_multiple_deprivation_imd_2007 (accessed 9 May 2011).
24. **Department of Health.** Caldicott Guardian Manual 2010. London: Department of Health, 2010.
25. **Office for National Statistics.** Super Output Areas Explained (Online). http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do?page=aboutneighbourhood/geography/superoutputareas/soa-intro.htm (accessed 14 Jul 2011).
26. **Sethi D,** Racioppi F, Baumgarten I, et al. Injuries and Violence in Europe. Why They Matter and What Can Be Done. Rome: WHO Regional Office for Europe, 2006.
27. **Stone DH,** Morrison A, Smith GS. Emergency department injury surveillance systems: the best use of limited resources? Inj Prev 1999;**5**:166—7.
28. **Hayden SR,** Barton ED, Hayden M. Domestic violence in the emergency department: how do women prefer to disclose and discuss the issues? J Emerg Med 1997;**4**:447—51.
29. **Birkenhead and Wallasey Primary Care Trust.** Wirral Evening and Night Time Strategy 2004-2008. Wirral: Birkenhead and Wallasey Primary Care Trust, 2004.
30. **Wirral DAAT.** Wirral's Alcohol Harm Reduction Strategy 2007—2010. Wirral: Wirral DAAT, 2007. http://www.wirraldaat.org
31. **Bellis MA,** Anderson Z, Hughes K. Effects of the Alcohol Misuse Enforcement Campaigns and the Licensing Act 2003 on Violence. A Preliminary Assessment of Accident and Emergency Attendances in Wirral. Liverpool: Centre for Public Health, John Moores University, 2006. http://www.tiig.info
32. **Flatley J,** Kershaw C, Smith K, et al. Crime in England and Wales 2009/10. Findings from the British Crime Survey and Police Recorded Crime. London: Home Office, 2010.
33. **Dines C.** Using A&E data to prevent violence in communities. Nurs Times 2011;**107**:16—18.
34. **Florence C,** Shepherd H, Brennan I, et al. Effectiveness of anonymised information sharing and use in health service, police, and local government partnership for preventing violence related injury: experimental study and time series analysis. BMJ 2011;**342**:d3313.
35. **Bellis MA,** Hughes K, Wood S, et al. National five-year examination of inequalities and trends in emergency hospital admission for violence across England. Inj Prev 2011;**17**:319—25.

### Young Australian travellers make travel insurance claims

Older Australian travellers pay higher travel insurance premiums even though it is those aged 23–30 who make the most claims mostly for damaged personal items, fractures or ligament injuries. Medical and dental claims were also high in this age group, compared with the 60–70 age group. Apparently, it is not the general health of travellers that is the issue but alcohol and mindless behaviour.

### The value of universal motorcycle helmet laws

A new CDC study shows that universal helmet laws that require every motorcycle rider and passenger to wear a helmet whenever they ride increases helmet use and saves money. In 2010, cost savings in states with universal motorcycle helmet laws were nearly four times greater (per registered motorcycle) than in states without these comprehensive laws. Annual costs saved from helmet use ranged from a high of $394 million in California (which has a universal helmet law) to a low of $2.6 million in New Mexico (which has a partial law or a law requiring that only certain riders wear helmets).

# IP

# Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms

Zara Quigg, Karen Hughes and Mark A Bellis

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# Short Report

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# Effects of the 2010 World Cup football tournament on emergency department assault attendances in England

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We explore the impact of the 2010 World Cup, held in South Africa, on levels of assault attendances to 15 emergency departments in England. The majority (70.1%) of assault attendees during the 2010 World Cup was male and aged 18–34 years (52.5%). Assault attendances increased by 37.5% on the days that England played ($P < 0.01$). Preparation for major sporting events in non-host countries should include violence prevention activity. Emergency department data can be used to identify violence associated with such events and thus inform both the targeting of prevention efforts and assessments of their effectiveness.

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## Introduction

Major international sporting events can raise significant public health challenges for both host and non-host countries.[1,2] World Cup football tournaments in particular attract widespread public attention from participating nations, and factors such as heightened emotions and alcohol consumption in spectators can contribute to increased violence.[3,4] For example, an English study found increases in assault-related ambulance call-outs immediately following a World Cup (2006) football match in which England played and later again in the evening.[2] Although major international football tournaments do not necessarily elevate overall emergency department (ED) attendances,[5] assaults can be among the most common causes of ED attendance related to football World Cups, often associated with alcohol use.[6] A Welsh study found that ED assault attendances increased on days when Wales played international rugby or football tournaments.[1] However, there is little information available on the impact of World Cup football tournaments, specifically on assault-related ED attendances.

The 2010 World Cup was held in South Africa and involved the England team in four of a possible seven matches. This report explores the impact of this World Cup on assault attendances to 15 EDs in England.

## Methods

Data were extracted from the Trauma and Injury Intelligence Group Injury Surveillance System[7] (hosted by the Centre for Public Health; www.tiig.info), which warehouses routine attendance data from EDs in the north west of England. Data are anonymized, and their use is governed through data-sharing protocols agreed with information-sharing leads (Caldicott guardians) at each participating ED.[7] ED attendances are categorized into injury groups, allowing the identification of assault attendances. Here, we analysed data from 15 EDs before (7th May–6th June), during (11th June–11th July) and after (16th July–15th August) the 2010 World Cup. Periods used for comparison in previous years (2007–09) cover the same periods matched on weekdays rather than dates and consequently include equal numbers of Fridays and Saturdays and equivalent number of days (31). Variables included in the analyses were age, sex and time/date of attendance. Additional variables were derived to indicate the days that England played and the World Cup period (i.e. pre, during and post). Days were re-coded into 24-h periods beginning at 6 am (e.g. Friday: Friday 6 am to Saturday 5.59 am).

Analyses utilized descriptive statistics with 95% confidence intervals (CIs) calculated from standard errors of the mean. Basic differences between means were tested using paired samples *t*-tests. Generalized linear modelling (GLM) was used to examine the independent effects of World Cup activity on levels of assault attendance. For the purposes of GLM, counts of assaults per day were square root transformed to ensure they approximated to a normal distribution (assault per day transformed, one sample Kolmogorov–Smirnov test for normality, $P = 0.339$). All variables were entered into the model. Data were analysed in SPSS version 17.

## Results

Throughout the World Cup period, there were a mean of 44.6 assault attendances per day. The majority (70.1%) was male and aged 18–34 years (52.5%). The first England game (vs. USA, 19:30 pm kick-off, score 1-1) took place on Saturday 12th June, the busiest day for assault attendances ($n = 88$) during the World Cup period. The days on which the three other England games took place (none of which were Saturdays) all saw between 56 and 58 attendances.

Figure 1 shows the mean daily number of assault attendances for the periods pre-, during and post-2010 World Cup and for equivalent periods in 2007, 2008 and 2009. Across all years, there were no significant differences in the daily number of assault attendances across the three periods. A general downward annual trend in assault attendances was seen across the 4 years (29.0% decrease, 95% CIs 22.7–35.3, $P < 0.001$). Between 2007 and 2010, the mean number of assault attendances per day decreased from 62.6 (95% CI 43.8–71.5) to 41.4 (95% CI 36.4–46.5) in the pre-World Cup period ($P < 0.001$), from 58.0 (95% CI 50.2–65.8) to 44.6 (95% CI 38.8–50.4) in the period during the World Cup ($P < 0.001$) and from 56.5 (95% CI 49.1–63.9) to 39.7 (95% CI 33.9–45.6) in the period post-World Cup ($P < 0.001$).

GLM was used to examine the independent effects of World Cup activity and other factors on levels of assault attendances. Results show that whether England played had a significant effect on assault attendances, which increased on these days [estimated marginal means; no England match: 47.6, 95% CI 46.3–48.9, England match 65.4, 95% CI 51.4–81.1; percentage increase = 37.5%, $P = 0.012$]. Other factors independently associated with assault attendances were day of the week (assaults were higher on Fridays, Saturdays
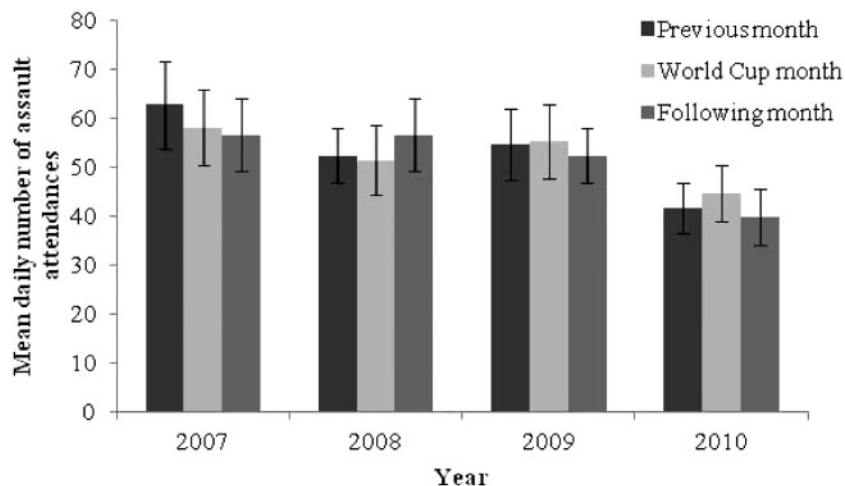
**Figure 1** Mean daily number of assault attendances to 15 EDs in the month during, before and after the 2010 World Cup and equivalent periods in 2007, 2008 and 2009. Bars represent 95% CI

and Sundays; $P < 0.001$), period (pre- and during World Cup periods were higher than the post period; $P < 0.05$) and year (attendances decreased each year; $P < 0.001$).

## Discussion

Understanding the effects of major sporting events on violence is critical in planning local and national responses, including health staffing requirements, service provision, policing responses and violence prevention activity. Our analysis found that during the 2010 World Cup, assault attendances across 15 EDs in England increased by one-third when England played. Although all England matches may present an increased risk of violence, impacts may be greater for those that occur on weekends when assaults are increased regardless of World Cup activity.[2]

A combination of factors are likely to influence levels of violence during major football tournaments, including the effects of winning or losing a game on supporters' emotions[4] and increases in alcohol consumption in both private and public settings. Although data on alcohol use is not collected by all EDs in our study, approximately half of all assault patients report having drank alcohol before violence, with alcohol-related violence most common in young males (those accounting for most assault presentations in our study).[7] Alcohol was widely promoted in England during the 2010 World Cup, and beer sales increased.[8,9] Up to 4 million adults were expected to watch the first England match in pubs while each England match attracted >13 million domestic television viewers,[10] with thousands more gathering in public places to watch on big screens. The congregation of large numbers of alcohol-consuming individuals with heightened emotions in public places creates potential for aggressive confrontation, while police reports of domestic violence also increase during major sporting events, often fuelled by alcohol.[4] Thus, preventing violence during major international football tournaments should be a priority. Efforts may be best focused on controlling alcohol promotions and preventing excessive alcohol consumption among spectators.[11] At present, however, with the alcohol industry as a major sponsor of World Cup events, powerful commercial interests are often favoured over public health; a point clearly demonstrated by measures to remove alcohol bans from Brazilian stadia during the forthcoming 2014 World Cup.[12]

During the 2010 World Cup, expected increases in violence in England led to the implementation of a range of prevention initiatives including awareness campaigns (e.g. domestic violence) and increased police enforcement activity. Our study could not control for any impacts of these interventions on ED assault attendances. Further, England were only involved in four matches during the

tournament, and the impact of the World Cup may have been different had England progressed to the final. Equally, our analysis focused on EDs in the north west of England and therefore does not account for regional variations. However, our study provides empirical evidence to support the need for prevention measures during World Cup tournaments and shows that ED data have the potential to identify violence associated with such events and thus inform both the targeting of prevention efforts and assessments of their effectiveness.

## Acknowledgements

## Funding

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### Key points

- Our study explores the impact of the 2010 World Cup, held in South Africa, on levels of assault attendances to 15 EDs in England.
- Findings show that on the days that England played, ED assault attendances significantly increased by one-third.
- Preparation for major sporting events in non-host countries should include violence prevention activity.
- Our study shows that ED data have the potential to identify violence associated with such events and thus inform both the targeting of prevention efforts and assessments of their effectiveness.

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## References

1 Sivarajasingham V, Moore S, Shepherd J. Winning, losing, and violence. *Inj Prev* 2005;11:69–70.

2   Deakin CD, Thompson F, Gibson C, Green M. Effects of international football matches on ambulance call profiles and volumes during the 2006 World Cup. *Emer Med J* 2007;24:405–7.

3   Kerr JH, Wilson GV, Nakamura I, Sudo Y. Emotional dynamics of soccer fans at winning and losing games. *Pers Individ Dif* 2005;38:1855–66.

4   Alcohol Concern. It's only a game: domestic abuse, sporting events and alcohol. London.

5   Cooke MW, Allan TF, Wilson S. A major sporting event does not necessarily mean an increased workload for accident and emergency departments. *Br J Sports Med* 1999;33:333–5.

6   Mattick AP, Mehta R, Hanrahan H, O'Donnell JJ. The Football World Cup 2002: analysis of related attendances to an Irish emergency department. *Ir Med J* 2003;96:90–1.

7   Quigg Z, Hughes K, Bellis MA. Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system

and its use in preventing violence and alcohol-related harms. *Inj Prev* 2011. doi:10.1136/injuryprev-2011-040159.

8   Alcohol Concern. Overexposed—alcohol marketing during the World Cup 2010. London.

9   British Beer and Pub Association. Cheer for beer, as World Cup and weather boosts beer sales. Available at: http://www.beerandpub.com/news/cheer-for-beer-as-world-cup-and-weather-boosts-beer-sales (31 May 2012, date last accessed).

10  TV Licensing. Telescope: a focus on the nation's viewing habits from TV Licensing, 2012. Available at: http://www.tvlicensing.co.uk/resources/library/BBC/MEDIA_CENTRE/TeleScope_report.pdf (31 May 2012, date last accessed).

11  World Health Organization and Centre for Public Health, LJMU. Preventing violence by reducing the availability and harmful use of alcohol. Geneva.

12  BBC News. Beer 'must be sold' at Brazil World Cup, says Fifa. Available at: http://www.bbc.co.uk/news/world-latin-america-16624823 (23 February 2012, date last accessed).

# Does legislation to prevent alcohol sales to drunk individuals work? Measuring the propensity for night-time sales to drunks in a UK city

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## ABSTRACT

**Background** By measuring alcohol retailers' propensity to illegally sell alcohol to young people who appear highly intoxicated, we examine whether UK legislation is effective at preventing health harms resulting from drunk individuals continuing to access alcohol.
**Methods** 73 randomly selected pubs, bars and nightclubs in a city in North West England were subjected to an alcohol purchase test by pseudo-drunk actors. Observers recorded venue characteristics to identify poorly managed and problematic (PMP) bars.
**Results** 83.6% of purchase attempts resulted in a sale of alcohol to a pseudo-intoxicated actor. Alcohol sales increased with the number of PMP markers bars had, yet even in those with no markers, 66.7% of purchase attempts resulted in a sale. Bar servers often recognised signs of drunkenness in actors, but still served them. In 18% of alcohol sales, servers attempted to up-sell by suggesting actors purchase double rather than single vodkas.
**Conclusions** UK law preventing sales of alcohol to drunks is routinely broken in nightlife environments, yet prosecutions are rare. Nightlife drunkenness places enormous burdens on health and health services. Preventing alcohol sales to drunks should be a public health priority, while policy failures on issues, such as alcohol pricing, are revisited.

## INTRODUCTION

Alcohol is a leading risk factor for burden of disease globally,[1] and the single leading risk factor in young people.[2] In the UK, alcohol is attributed to more than one in five deaths in those aged 16–24 years.[3] Around two million presentations to English emergency departments (ED) annually are alcohol-related, with patients most likely to be young males,[4] contributing to a service nearing collapse.[5] While much of the health harms in young people are accounted for by acute conditions, such as road traffic injury, suicide and violence,[3] they are also increasingly affected by chronic alcohol-related conditions such as liver disease.[6] Such increases in alcohol-related mortality and morbidity in younger adults are overshadowing health gains made elsewhere (eg, cervical screening),[7] yet despite this, public health calls for stronger legislation to curb deaths, injury and illness from alcohol repeatedly lose out to the interests of industry.[8] Thus, the introduction of a minimum alcohol unit price for England has been withdrawn despite evidence it would reduce premature mortality and antisocial behaviour.[9] Instead, government has called on local authorities and public services to use existing powers and voluntary agreements with industry to reduce alcohol-related harms.[10]

As statutory partners in reducing crime and disorder and responsible authorities under licensing legislation,[11] public health professionals are well placed to drive local action to prevent alcohol-related harm. Moreover, an existing legal power has the potential to reduce drunkenness and its health impacts. UK law prohibits sale of alcohol to anyone already drunk,[11] yet, convictions for this are extremely rare (three in 2010).[12] While alcohol retailers insist that sales to drunks do not occur, 70% of ED attendances between midnight and 5:00 being alcohol-related suggests otherwise.[13] The impacts of inebriation on those in ED are manifest. However, other consequences, such as domestic violence, child maltreatment and unintentional injuries, occurring when individuals return home, are frequently unrecorded.

Studies outside the UK have tested bar server propensity to over-serve alcohol,[14 15] and used findings to drive enforcement activity, raise server standards and reduce sales to drunks.[16] Here, we examine whether servers in UK bars sell alcohol to people showing clear signs of intoxication, and consider implications for policy and practice.

## METHODS

The study took place in a city centre in North West England. Four student actors (two male, two female, aged 20–22 years) were recruited through an audition process and trained on acting drunk. Young adult actors were used as test purchasers due to this demographic being the most common users of city centre nightlife environments. A standard act for pseudo-intoxicated alcohol purchase attempts was developed and tested with police (who are legally able to act as expert witnesses for determining drunkenness). The act ensured that a very high level of intoxication was portrayed through key indicators (eg, slurred speech, unsteadiness on feet, difficulty focusing) and that sufficient interaction occurred between actors and bar servers to allow these indicators to be observed.

Venues subjected to alcohol purchase test (n=73) were randomly selected from all (n=317) city centre pubs, bars and nightclubs. Proportionate allocation sampling was used with venues stratified by permitted operating hours (latest closing times through licensing conditions: <midnight, 9%; midnight–<2:00, 23%; 2:00–<4:00 36%, 4:00 or later 33%). Venues no longer operating were

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replaced from the same strata. Alcohol purchase attempts were made by two actors and observed by two researchers (May 2013, Wednesday–Sunday nights, 21:00–3:00). Researchers entered venues first to surreptitiously observe purchase attempts and venue characteristics. One actor took the role of the 'drunk' and the other a 'sober' friend. The pseudo-drunk actor stumbled to the bar with the support of the sober friend and using loud, slurred speech asked the price of a vodka and coke. Upon receipt of the price, they fumbled over their purse/wallet and asked for the drink. Actors left the venue immediately if service was refused or shortly after service where this occurred, leaving the drink behind. Observers left a few minutes later. Observers and actors then completed structured observational schedules detailing venue characteristics (eg, crowding, noise levels, presence of door staff) and, for actors, aspects of the alcohol purchase attempt (included in this analysis: service refusal tactics, description of purchase attempt). Observational measures of venue characteristics were drawn from an established tool developed by Graham et al[17] and used in previous studies of bar environments.[17–19]

Analysis was undertaken in SPSS (V.20) using $\chi^2$ and analysis of variance (ANOVA). To examine relationships between alcohol purchase attempt outcomes and bar characteristics, 10 established markers of poorly managed and problematic (PMP) bars[17] were drawn from observational data: low levels of seating, cheap alcohol promotions, young bar servers, young clients, high noise levels, crowding, poor lighting, rowdiness, dirtiness and customer intoxication (see table 1). $\chi^2$ Analysis identified that these variables were significantly correlated with each other. Thus, the latter six were all significantly related to each other; noise, rowdiness and customer intoxication were also associated with young bar servers; crowding was associated with young clients; and young bar servers and young clients were associated with alcohol promotions. Thus, dichotomised variables were summed into a PMP score for each venue. Ethical approval was obtained from Liverpool John Moores University, and the study adhered to the Declaration of Helsinki.

## RESULTS

Of the 73 purchase attempts, 61 resulted in a sale of alcohol to a pseudo-drunk actor (83.6%; table 1). Service rates were always high, ranging from 60.0% on Wednesdays to 94.1% on Fridays, and from 78.4% served before midnight to 95.5% after midnight. Day and time differences were not significant (p=0.242, p=0.072, respectively). There were no differences in service outcomes by gender of the pseudo-drunk actor or gender mix of the actor pair. Across the 10 markers of PMP examined, only greater seating provision and older bar staff (most >25 years) were individually associated with decreased service to pseudo-drunk actors. However, service rates increased with PMP score. Thus 66.7% of bars with no PMP markers served alcohol to actors rising to 100% of bars with ≥8 (table 1). Pseudo-drunk actors were also more likely to be served in bars with door supervisors (95.1% served, v 68.8% in bars without door supervisors, p=0.003). Most sales occurred without hesitation, despite actors' notes suggesting that servers often recognised drunkenness (see box). Service refusal typically occurred through direct refusal statements (eg, 'sorry, you're too drunk') with other techniques, including use of caring statements, gaining support from other staff, or simply ignoring the actor (see box). Critically, in 18% of alcohol sales, actors' notes indicated that the bar server attempted to up-sell the actor a double rather than single vodka.

**Table 1** Service rates to pseudo-drunk actors in venues with and without markers of poorly managed and problematic (PMP) bars

| PMP markers* | n | Per cent served | $\chi^2$ | p Value |
|---|---|---|---|---|
| **Low seating** | | | | |
| No | 42 | 76.2 | | |
| Yes | 26 | 96.2 | 4.720 | 0.030 |
| **Cheap drink promotions** | | | | |
| No | 39 | 82.1 | | |
| Yes | 34 | 85.3 | 0.139 | 0.709 |
| **Young bar staff** | | | | |
| No | 40 | 72.5 | | |
| Yes | 33 | 97.0 | 7.882 | 0.005 |
| **Young customers** | | | | |
| No | 56 | 78.6 | | |
| Yes | 14 | 100.0 | 3.621 | 0.057 |
| **Noisy bar** | | | | |
| No | 47 | 80.9 | | |
| Yes | 26 | 88.5 | 0.706 | 0.401 |
| **Crowded bar** | | | | |
| No | 57 | 82.5 | | |
| Yes | 16 | 87.5 | 0.231 | 0.630 |
| **Poor lighting** | | | | |
| No | 62 | 82.3 | | |
| Yes | 11 | 90.9 | 0.509 | 0.476 |
| **Rowdy bar** | | | | |
| No | 54 | 79.6 | | |
| Yes | 19 | 94.7 | 2.335 | 0.126 |
| **Dirty bar** | | | | |
| No | 53 | 81.1 | | |
| Yes | 20 | 90.0 | 0.831 | 0.362 |
| **Drunk customers** | | | | |
| No | 50 | 78.0 | | |
| Yes | 21 | 95.2 | 3.129 | 0.077 |
| **Number of PMP markers** | | | | |
| None | 15 | 66.7 | | |
| 1 or 2 | 26 | 80.8 | | |
| 3 or 4 | 10 | 90.0 | | |
| 5–7 | 16 | 94.1 | | |
| 8–10 | 5 | 100.0 | 5.491 | 0.019 |

*PMP, poorly managed and problematic bars: Low seating, <50% venue floor area with seating; young bar staff, >50% appear <age 25; young customers, most appear <age 25; noisy bar, crowded bar, poor lighting, dirty bar, rowdy bar, drunk customers, ratings of five or above on scales of 0 to 9 grading the presence of the marker (eg, noisy bar; 0=very quiet/easy to talk, 9=hurts ears/cannot talk).[17]

## DISCUSSION

Alcohol purchase attempts by pseudo-drunk actors in UK bars suggest that the law preventing sale of alcohol to drunks is routinely broken. Over four in five purchase attempts resulted in an alcohol sale despite actors portraying signs of overt drunkenness and bar servers often recognising such signs. Alcohol sales to pseudo-drunk actors increased with number of PMP markers observed in bars, yet even in bars with no such markers, two-thirds of purchase attempts resulted in a sale. Continued provision of alcohol to drunks will increase risks of acute and long-term health and social harms, and consequently, the burdens these place on public services and society.

Although our study focused on one city, a lack of prosecutions for sales to drunks throughout England suggests this is typical of nightlife environments nationally. Across the country, police and licensing authorities work closely with bars to improve standards, yet with the principle objective of reducing

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**Box Sample extracts from actors' notes on exchanges with bar servers:**

Incidents resulting in bar service
▶ Bar tender rolled his eyes when he saw me swaying but he still served me.
▶ Bar tender asked "are you sure you're okay for this?" then served me.
▶ When bar tender was serving my drink the other bar tender said "You serving her? Look at her eyes"—he said "well, I've poured it now".
▶ Asked for a drink. They only served doubles. Bar tender said "have you been drinking elsewhere tonight?" I said "yeah" and he said "OK, I'll give you one but no more tonight, you've had enough".
▶ Even with [actor's] head on the bar and slurring his words, there was no hesitation for sale. In fact the barman offered him a double.

Incidents resulting in service refusal
▶ Bar tender touched my arm and said "sorry love, you've had a little too much to drink".
▶ He asked me if I'd had enough and then went on to say "I don't want you to fall down the stairs". Then as I was leaving he said "be careful and watch out for the step".
▶ Bar tender poured drink, discussed with another bar maid then said "sorry mate, you're too drunk".
▶ I was asked if I would stay awake to drink the drink and was then told to leave.
▶ Server said "Can't serve you honey, would you like a glass of water?"

the antisocial behaviour associated with drunkenness rather than drunkenness itself.[20] While the health consequences of extreme intoxication are unambiguous, local authorities may be concerned that moves to reduce nightlife alcohol use will damage local night-time economies along with convivial relationships with bars. Equally, with such widespread disregard for the law, police may consider the task of identifying and prosecuting drunken sales overwhelming. However, in other countries, illegal alcohol sales to drunks have been significantly reduced through combined enforcement and awareness-raising based on findings from studies such as this.[16] Importantly, just a few prosecutions for selling alcohol to drunks in an area could change the norm of flouting the law.

While servers cannot be prosecuted for selling alcohol to people who are only pretending to be drunk, test purchasing is just one mechanism that can identify bars where illegal sales occur in order to target preventative measures.[21] Such measures include issuing venues with notices warning that they are being observed for breaches of licensing legislation and mandatory staff training to develop service refusal policies and skills. Our finding that venues with door supervisors were more likely to serve alcohol to drunks may reflect confusion among staff about who is responsible for controlling service to drunks, with bar servers believing that individuals permitted into the bar have already been deemed appropriate for service. Ensuring bar servers are aware of their legal responsibilities and the consequences that sales of alcohol to drunks can impose on them personally is crucial. While our study has focused on sales of alcohol to drunks in bars, such sales are also likely to occur in off-licensed premises and the extent of such illicit sales requires

examination. Underage alcohol sales, however, have been studied previously,[22] and test purchasing is now routinely carried out by authorities across the UK.[23] Here, campaigns such as Challenge 25[24] have supported alcohol servers in on-licensed and off-licensed alcohol outlets to uphold the law. Such campaigns use highly visible signage (eg, posters, badges for staff) transmitting the message that underage sales are not permitted, and that staff will ask any individual appearing under age 25 for proof of age. Similar schemes could be used to raise awareness of laws against sales to drunks, transmit the message that such sales will not be permitted, and provide a mechanism to support staff in service refusal.

Recent policy discussions in the UK and elsewhere have focused on alcohol pricing, with problems of nightlife drunkenness compounded by the consumption of cheap off-licensed alcohol before nights out.[25] Sales of alcohol to drunks in bars are likely to contribute to such preloading, as they permit individuals who arrive in town and city centres drunk to continue to access alcohol. Effective enforcement of legislation preventing sales of alcohol to drunks, combined with awareness-raising that drunks will not get served, could reduce preloading, and shift social norms away from drunkenness in nightlife settings. In turn, reducing the prevalence of heavy intoxication in nightlife could have major benefits in opening up nightlife to individuals of all ages and beliefs, including those who do not want to socialise in an environment where being drunk is the norm.

While debate on the need for new legislation to reduce alcohol harms continues, more could be done to better enforce existing laws. Leaving the alcohol industry to self-regulate is unlikely to be effective, as a single bar in an area still prepared to serve drunks would benefit from those rejected from compliant bars. Moreover, enforcing no alcohol sales to drunks would impact most heavily on the biggest consumers with nearly 80% of alcohol consumed by the 30% heaviest drinkers nationally.[26] For the same reason, however, it is a highly targeted health measure that would specifically impact on heavy drinkers that get drunk. Any impacts on moderate social drinkers may, in fact, be beneficial; while not changing their drinking behaviours, the reduced presence of heavily intoxicated individuals in nightlife would help reduce moderate drinkers' exposure to the collateral damage caused by drunks. Moreover, reducing attendances at EDs and other health services resulting from drunkenness should improve access for others patients and help alleviate increasing service pressures. Health professionals have been instrumental in instigating change in nightlife management elsewhere (eg, smoking bans, safer glassware). Here also, stopping sales of alcohol to drunks requires advocacy from health professionals who routinely see the damage severe intoxication causes to drunks and those hurt through their actions.

**What is already known on this subject?**

Drunkenness is rife in nightlife environments in the UK, and the health and social harms linked to such intoxication place major burdens on individual health, public services and broader society. Despite service of alcohol to people who are drunk being illegal, prosecutions are rare. Studies outside the UK suggest that measuring propensity for servers to sell alcohol to drunks may be an important precursor to better enforcement of legislation, reducing sales to drunks and ultimately reducing the harms associated with alcohol bingeing.

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## What this study adds?

In UK bars, over four in five alcohol purchase attempts by young actors portraying signs of extreme intoxication resulted in a sale of alcohol despite servers often clearly recognising drunkenness. Although service to drunks was more common in poorly managed bars and clubs, it was the norm even in well-managed premises. With policies to prevent alcohol-related harm by increasing alcohol prices failing to be implemented, increased use of legislation preventing sales of alcohol to drunks should be considered a public health priority.

## REFERENCES

1. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2224–60.
2. Gore FM, Bloem PJN, Patton GC, et al. Global burden of disease in young people aged 10–24 years: a systematic analysis. Lancet 2011;377:2093–102.
3. Jones L, Bellis MA, Dedman D, et al. Alcohol-attributable fractions for England: alcohol-attributable mortality and hospital admissions. Liverpool: Centre for Public Health, Liverpool John Moores University, 2008.
4. Hoskins R, Benger J. What is the burden of alcohol-related injuries in an inner city emergency department? Emerg Med J 2013;30:e21.
5. House of Commons Health Select Committee. Health Committee—second report: urgent and emergency services. 2013. http://www.publications.parliament.uk/pa/cm201314/cmselect/cmhealth/171/17102.htm (accessed 21 Aug 2013).
6. Sheron N, Olsen N, Gilmore I. An evidence-based alcohol policy. Gut 2008;57:1341–4.
7. Murray CJ, Richards MA, Newton JN, et al. UK health performance: findings of the Global Burden of Disease Study 2010. Lancet 2013;381:997–1020.
8. McCambridge J, Hawkins B, Holden C. Industry use of evidence to influence alcohol policy: a case study of submissions to the 2008 Scottish government consultation. PLoS Med 2013;10:e1001431.
9. Meng Y, Brennan A, Holmes J, et al. Modelled income group-specific impacts of alcohol minimum unit pricing in England in 2014/15: policy appraisals using new developments to the Sheffield Alcohol Policy Model (v2.5). Sheffield: University of Sheffield, 2013.
10. Home Office. Next steps following the consultation on delivering the Government's alcohol strategy. London: Home Office, 2013.
11. Parliament of the United Kingdom. Licensing Act 2003. http://www.legislation.gov.uk/ukpga/2003/17/contents (accessed 21 Aug 2013).
12. HM Government. The government's alcohol strategy. Norwich: The Stationery Office Limited, 2012.
13. Drummond C, Phillips T, Coulton S, et al. National prevalence survey of alcohol-related attendances at accident and emergency departments in England. Alcohol Clin Exp Res 2005;29:36A.
14. Lenk KM, Toomey TL, Erickson DJ. Propensity of alcohol establishments to sell to obviously intoxicated patrons. Alcohol Clin Exp Res 2006;30:1194–9.
15. Andreasson S, Lindewald B, Rehnman C. Over-serving patrons in licensed premises in Stockholm. Addiction 2000;95:359–63.
16. Wallin E, Gripenberg J, Andreasson S. Overserving at licensed premises in Stockholm: effects of a community action program. J Stud Alcohol 2005;66:806–14.
17. Graham K, Bernard S, Osgood DW, et al. Bad nights or bad bars? Multi-level analysis of environmental predictors of aggression in late-night large-capacity bars and clubs. Addiction 2006;101:1569–80.
18. Hughes K, Quigg Z, Bellis MA, et al. Drunk and disorganised: relationships between bar characteristics and customer intoxication in European drinking environments. Int J Environ Res Public Health 2012;9:4068–82.
19. Buvik K. How bartenders relate to intoxicated customers. Int J Alcohol Drug Res 2013;4:1–6.
20. Bellis MA, Hughes K. Getting drunk safely? Night-life policy in the UK and its public health consequences. Drug Alcohol Rev 2011;30:536–45.
21. Graham K, Miller P, Chikritzhs T, et al. Reducing intoxication among bar patrons: some lessons from prevention of drinking and driving. Addiction 2013; Epub ahead of print. doi:10.111/add./12247.
22. Willner P, Hart K, Binmore J, et al. Alcohol sales to underage adolescents: an unobtrusive observational field study and evaluation of a police intervention. Addiction 2000;9:1373–88.
23. LACORS. A practical guide to test purchasing. 2010. http://www.lacors.gov.uk/lacors/upload/23992.pdf (accessed 20 Nov 2013).
24. Home Office. Selling alcohol responsibly: good practice examples from the alcohol retail and hospitality industries. London: Home Office, 2010.
25. Hughes K, Anderson Z, Morleo M, et al. Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. Addiction 2008;103:60–5.
26. Booth A, Meier P, Stockwell T, et al. Independent review of the effects of alcohol pricing and promotion. Part A: systematic reviews. Sheffield: University of Sheffield, 2008.

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# Nighttime assaults: using a national emergency department monitoring system to predict occurrence, target prevention and plan services

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## Abstract

**Background:** Emergency department (ED) data have the potential to provide critical intelligence on when violence is most likely to occur and the characteristics of those who suffer the greatest health impacts. We use a national experimental ED monitoring system to examine how it could target violence prevention interventions towards at risk communities and optimise acute responses to calendar, holiday and other celebration-related changes in nighttime assaults.

**Methods:** A cross-sectional examination of nighttime assault presentations (6.01 pm to 6.00 am; n = 330,172) over a three-year period (31st March 2008 to 30th March 2011) to English EDs analysing changes by weekday, month, holidays, major sporting events, and demographics of those presenting.

**Results:** Males are at greater risk of assault presentation (adjusted odds ratio [AOR] 3.14, 95% confidence intervals [CIs] 3.11-3.16; P < 0.001); with male:female ratios increasing on more violent nights. Risks peak at age 18 years. Deprived individuals have greater risks of presenting across all ages (AOR 3.87, 95% CIs 3.82-3.92; P < 0.001). Proportions of assaults from deprived communities increase midweek. Female presentations in affluent areas peak aged 20 years. By age 13, females from deprived communities exceed this peak. Presentations peak on Friday and Saturday nights and the eves of public holidays; the largest peak is on New Year's Eve. Assaults increase over summer with a nadir in January. Impacts of annual celebrations without holidays vary. Some (Halloween, Guy Fawkes and St Patrick's nights) see increased assaults while others (St George's and Valentine's Day nights) do not. Home nation World Cup football matches are associated with nearly a three times increase in midweek assault presentation. Other football and rugby events examined show no impact. The 2008 Olympics saw assaults fall. The overall calendar model strongly predicts observed presentations (R[2] = 0.918; P < 0.001).

**Conclusions:** To date, the role of ED data has focused on helping target nightlife police activity. Its utility is much greater; capable of targeting and evaluating multi-agency life course approaches to violence prevention and optimising frontline resources. National ED data are critical for fully engaging health services in the prevention of violence.

**Keywords:** Violence, Assaults, Emergency department, Nighttime, Deprivation, Monitoring

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## Background

Globally, interpersonal violence is a major threat to health [1]. It causes over half a million deaths each year and is a leading cause of mortality and morbidity in young people [2]. Treating the physical and mental health impacts of violence imposes significant costs on health services [3]. The burden of violence falls disproportionately on lower and middle income countries [1], yet even in England and Wales there are estimated to be over two million incidents of violence against adults and at least half a million more against children each year [4], resulting in annual costs to the health service of over £2 billion [5]. Assaults on health service staff alone cost around £60 million per year [6]. When broader economic, criminal justice, and social impacts are included violence is estimated to cost the country £24 billion annually [5]. Across England surveys suggest that 67% of assaults occur at nighttime [4]; often following alcohol consumption. Nearly half (44%) of all assaults are alcohol-related (equivalent to almost one million annually) and one in five takes place near a bar, pub or other licensed drinking venue [4].

The immediate nature of treatment required for assaults, and their focus in nighttime hours, means resulting injuries impact particularly on emergency department (ED) services. This relationship has resulted in ED data being recognised by the World Health Organization as key intelligence for the development, implementation, and evaluation of violence prevention initiatives [7,8]. Importantly, in both the UK and elsewhere, a large proportion of assaults resulting in ED treatment are not reported to police [9-11]. Consequently, the intelligence EDs can add to existing criminal justice systems has led to the development of local and regional ED violence surveillance systems in some countries (e.g., UK [11,12], Jamaica [13], Colombia, El Salvador and Nicaragua [14]). Assault location, which can be recorded when individuals present in the ED, has been used to target police and licensing authority enforcement activity on assault 'hot spots' such as problem bars with some success in reducing violence [11,12]. However, the utility of robust ED data in violence prevention is not limited to targeting judicial activity. Numerous studies identify effective roles for health care and public health services in violence prevention; including through identifying and supporting victims [15], and through commissioning and delivering selective (e.g., perinatal support, parenting programmes, and pre-school enrichment) and indicated (e.g., cognitive behavioural therapy and multisystemic therapy) prevention programmes [16-20]. ED data could be used to target such interventions at those communities and individuals most at risk of violence so long as residential data are collected [21]. Moreover, retrospective ED data may be used to predict

and prepare for future pressures on services created by the economy (e.g., recession [22]), calendar events (e.g., new national holidays [23]), festivals and sporting occasions (e.g., Olympics [24]) or changes in policy (e.g., national alcohol licensing [25]). With often limited health resources, such intelligence should inform more effective and economic service planning; helping ensure services are better directed to when and where they are needed. Nevertheless, globally the national ED data systems required to examine these issues on a routine basis are almost entirely absent [26,27].

England began an experimental national ED data collection system in 2007 [28]. These data are used here to examine the demographic characteristics of those presenting for nighttime assaults and the impact of temporal events (day of week, bank holidays, seasons, special events) on nighttime ED assault attendances in different communities. We examine how such data could be used nationally and locally to minimise assaults through: targeting prevention interventions at those communities and individuals most affected by violence; better planning of, and preparation for, holidays and events; and optimising the deployment of front line resources.

## Methods

Since 1989, the Hospital Episodes Statistics (HES) service has recorded all episodes of inpatient care at National Health Service hospitals across England, including private patients. In 2007, the HES system was expanded to record a basic dataset of all presentations in accident and emergency services (HES A&E), including major EDs, single speciality EDs, walk-in centres and minor injury units. The dataset records age, sex, time, date of attendance, and postcode of attendee's residence. It classifies attendance into nine broad categories (road traffic accident, assault, deliberate self-harm, sports injury, firework injury, other accident, brought in dead, other than above and not known) [28]. Data also distinguish first time attendances from follow-ups. Data are collated throughout the care pathway by administrative and medical staff in emergency services and are submitted, from patient administrative systems, by clinical service providers to a national Secondary Uses Service [29] for planning, monitoring and other research purposes. The content and access to the HES service are managed by the Health and Social Care Information Centre [30]. Currently, 187 clinical service providers contribute any data to the HES A&E system, compared with 327 providers contributing to the QMAE system (Quarterly Monitoring of Accident and Emergency data; a simple national count of solely number of attendances at any emergency service). However, all 150 providers with major EDs contribute data (covering 199 major EDs,

including 9 children's EDs) with non-contributors accounted for by smaller or specialist emergency services (e.g., walk in centres and minor injury units) which are typically closed over night. Despite all providers with major EDs contributing to the HES A&E system, data are incomplete. Providers with major EDs submitted data on a total of 14,821,225 attendances for any reason in 2010/11, compared with 15,712,068 attendances reported through QMAE (94.3% coverage). However, data from nine providers included no cases of violence, indicating that data coding issues remain in this experimental data system.

For the period 31st March 2008 to 31st March 2011 all first time presentations (i.e., excluding follow up presentations) for assaults were extracted from the HES A&E data (n = 526,687). The HES system automatically maps postcode of residence to lower super output areas (LSOAs; geographical areas with a population mean of 1500 designed to standardise reporting of small area statistics in England and Wales [31]). Each LSOA has an average measure of deprivation routinely calculated across residents based here on the 2010 Index of Multiple Deprivation (IMD), a composite measure that includes 38 indicators relating to health, economic and educational status [32]. We assigned presentations to a national quintile of deprivation based on the IMD values of their LSOA [33]. While data were available for ED presentations at any time of day, we limited analysis to night times (6:01 pm-6:00 am; n = 330,172; 62.7% of all recorded attendances), when EDs are practically the only treatment option for those requiring immediate attention and thus data are not confounded by choice of different treatment services. In the final HES A&E data set 98.8% of nighttime assault presentations were from major EDs and 1.2% from other data providers (e.g. walk in and minor injury units).

For any day, the 12 hour nighttime period was assigned to the date relating to the first six hours (e.g., attendances occurring between 6:01 pm on 29/09/2009 and 6:00 am 30/09/2009 = nighttime attendances for 29/09/2009 [11]). As a result complete data were only available between 31st March 2008 and 30th March 2011 and analyses were limited to this period. Where denominator populations were required we used 2009 mid-year populations by age, sex, and deprivation; with deprivation again being based on the LSOA of residence. For temporal analyses, discrete calendar dates and events were chosen on the basis of whether they were nationally stipulated public holidays, established dates commemorating well known individuals or events on a national basis or, sporting events of national interest (Table 1). All data provided through HES A&E are anonymised but the system can assign individuals with a unique identifier. For our sample, while some individuals presented for nighttime assaults more than once in the three-year period (number of times presenting; 1, 93.3%; 2, 5.8%; >2 0.9%) analyses focus on number of presentations, not individuals.

Data were extracted for analysis in Predictive Analytics Software (PASW®) Version 18. Analysis used ANOVA for direct comparisons between different daily assault attendances. Binary logistic regression (LR) was used for calculation of adjusted odds of attendance by demography with non-attendees calculated by age, sex, and deprivation specific subtraction of assault presentations from national matching population numbers. LR was used as the dependent variable was binary and the categorical independent variables fulfilled the criteria for such modelling [34]. Generalised linear modelling (GLM) is a robust technique for modelling count data (e.g., here presentations per day) over a fixed time period [35] and was employed here to examine independent impacts of calendar days, holidays, and sporting events on nighttime attendance levels. Although a large data set, over the three-year period some calendar events occur just one day a year (e.g., New Year's Eve). Thus, to reflect the range of reliability, confidence intervals are presented for both basic descriptive statistics (Table 2) and modelled relationships (Table 3). Deprivation rate ratios (DRRs) were calculated as the ratio of the most deprived quintile (IMD5) to the most affluent (IMD1) for gender specific rates in single year of age categories up to age 75 years. With data conforming to normality, comparisons between deprivation rate ratios for males and females used a paired (by age) sample T test.

The HES data system is specifically compiled in order to be used for planning and research purposes [30]. The Centre for Public Health is compliant with the HES Protocol [36] (which covers data access and sharing issues) under the terms and conditions of which it undertakes work on HES data relating to the epidemiology of violence and alcohol and disseminates such information. Consequently, further ethical approval for analyses on this existing data system was not required.

## Results

Overall, 75.8% of presentations were male with 48.7% of all nighttime assault presentations falling on Friday and Saturday nights. Age at presentation peaked in teenagers and younger adults (under 15 years, 4.0%; 15–24 years, 45.9%; 25–34 years, 23.8%; 35–54 years, 22.9%; 55 years or over, 3.4%) with the lowest levels of nighttime presentations in those under 15 or over 54 years.

### Weekends and holidays

Consistent with findings from other ED and criminal justice studies [11,37,38], nighttime assaults here show strong weekly peaks in presentations on Friday and

**Table 1 Calendar and sporting events included in assault presentation analyses**

| Event | Details |
|---|---|
| *Calendar* | |
| Year[1] | 2008/09-2010/11 |
| Month of year | January to December |
| Day of week | Sunday to Saturday |
| English bank holidays | Any national public holiday |
| England bank holiday eves | Day before a public holiday |
| New Year's eve and day | 31st December and 1st January |
| Christmas eve and day | 24th and 25th December |
| Last and first week of month and last and first two days of month | Examining payday effects e.g., celebrating receiving a monthly wage |
| St George's day | 23rd April |
| St Patrick's day | 17th March |
| Halloween | 31st October |
| Guy Fawkes (Bonfire) night | 5th November |
| Valentine's day | 14th February |
| *Sporting Events* | |
| Football Association Cup | Annual finals |
| UEFA Champions League Final | Union of European Football Associations Champions League final |
| Football World Cup 2010 | Includes only England matches |
| Rugby Six nations | Includes only England matches annually |
| Summer Olympic Games 2008 | 8th-24th August 2008 |

[1] Years run from 31st March to 30th March to account for time-shifted data.

Saturday nights (Table 2). England has a series of set one-day public holidays each year (see Table 1). The nighttimes of these holidays were not associated with an increase in assault presentations. However, their eves (nights before the holiday) showed significant increases in assaults (Table 2). New Year's Eve showed a greater increase in assaults than that associated with other bank holidays, while the increase seen on Christmas Eve was consistent with increases with bank holidays generally (Table 2). Consequently Christmas Eve, but not New Year's Eve, was incorporated with other bank holidays in further analyses, and nights of the week were categorised as Sunday-Thursday and Friday-Saturday. Using GLM to test the independent significance of calendar effect, the impacts of Friday-Saturday, bank holiday eves, and the even greater impact of New Year's Eve on increasing assaults were maintained (Table 3).

**Annual and monthly effects**

There was no significant impact of year (Table 2) and consequently this was eliminated from further analyses. Bivariate analyses identified an increase in nighttime assault presentations over the summer months (Table 2). End of month effects (the impact of being paid at the end of month) were not apparent either when examining the first or last two days or the first or last week of months, and therefore were eliminated from further analyses (Table 2). Using GLM, monthly assaults showed an overall nadir in January with a rise over the summer period, peaking in August (Table 3).

**Celebrations without a public holiday**

A number of other national celebrations (not linked to holidays) were included in the GLM analyses (Table 1). Halloween, Guy Fawkes and St Patrick's nights were all associated with significantly increased levels of assault presentations (Table 3). However, St George's Day and Valentine's Day nights had no significant impact. Figure 1 shows how holiday eves and some non-holiday related celebrations increased assaults within certain months of the year, when they occurred on (a) Fridays-Saturdays or (b) Sundays-Thursdays.

**Sporting events**

Figures 1a and 1b also identify the relationship between key sporting events and increased assaults. Of those examined, the greatest increase in assault presentations was associated with national team (England) matches in the football 2010 World Cup; with presentations nearly tripling when matches occurred on Sunday-Thursday evenings (June; Figure 1a). Finals of the Football Association Cup, the Union of European Football Associations Champions League, and Rugby Six Nations England matches showed no significant impact (Table 3). However, the

**Table 2 Variations with calendar event in average numbers$^\$$ of per evening assault presentations across English emergency department services**

| Calendar events | | Days | All attendances | | | | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 95% CI | | | | 95% CI | | | | 95% CI | | |
| | | | Mean | Low | Up | Sig | Mean | Low | Up | Sig | Mean | Low | Up | Sig |
| All days | | 1095 | 301.4 | 292.1 | 310.8 | | 227.3 | 219.7 | 234.9 | | 72.6 | 70.8 | 74.4 | |
| Holidays | No holiday | 1072 | 301.7 | 292.1 | 311.2 | 0.946 | 227.7 | 219.9 | 235.4 | 0.869 | 72.5 | 70.7 | 74.3 | 0.940 |
| | Bank holiday | 18 | 287.7 | 236.6 | 338.8 | | 209.1 | 168.0 | 250.2 | | 77.0 | 66.8 | 87.2 | |
| | Christmas | 3 | 264.0 | 154.8 | 373.2 | | 189.7 | 95.8 | 283.6 | | 73.3 | 58.2 | 88.5 | |
| | New Year | 3 | 278.0 | 161.6 | 394.4 | | 205.0 | 88.8 | 321.2 | | 72.7 | 66.4 | 78.9 | |
| Holiday | No holiday | 1071 | 296.0 | 287.0 | 305.0 | <0.001 | 222.9 | 215.6 | 230.2 | <0.001 | 71.6 | 69.9 | 73.4 | <0.001 |
| Eves | Bank holiday | 18 | 447.1 | 390.0 | 504.1 | | 340.9 | 293.5 | 388.4 | | 102.2 | 92.2 | 112.3 | |
| | Christmas | 3 | 485.3 | 422.2 | 548.5 | | 399.7 | 323.2 | 476.0 | | 83.3 | 54.5 | 112.1 | |
| | New Year | 3 | 1196.3 | 975.0 | 1417.7 | | 956.7 | 765.1 | 1148.2 | | 231.0 | 185.4 | 276.6 | |
| Day$^i$ | Sunday | 142 | 230.2 | 221.8 | 238.6 | <0.001 | 166.2 | 159.6 | 172.9 | <0.001 | 62.9 | 60.7 | 65.2 | <0.001 |
| | Monday | 156 | 198.6 | 193.2 | 204.0 | | 143.6 | 139.5 | 147.7 | | 54.2 | 52.3 | 56.0 | |
| | Tuesday | 157 | 186.1 | 181.0 | 191.3 | | 132.9 | 128.9 | 136.8 | | 52.5 | 50.8 | 54.2 | |
| | Wednesday | 155 | 197.8 | 190.7 | 204.8 | | 143.6 | 137.7 | 149.5 | | 53.4 | 51.6 | 55.2 | |
| | Thursday | 151 | 227.2 | 221.2 | 233.2 | | 170.1 | 165.3 | 174.9 | | 56.0 | 54.3 | 57.8 | |
| | Friday | 154 | 503.1 | 491.8 | 514.3 | | 393.2 | 383.7 | 402.6 | | 107.1 | 104.5 | 109.6 | |
| | Saturday | 156 | 523.1 | 509.1 | 537.0 | | 406.0 | 395.0 | 417.0 | | 114.3 | 111.0 | 117.6 | |
| Calendar | Jan | 92 | 246.0 | 219.7 | 272.3 | <0.001 | 184.9 | 163.5 | 206.4 | 0.003 | 59.9 | 54.9 | 64.9 | <0.001 |
| Month$^i$ | Feb | 84 | 280.8 | 249.0 | 312.6 | | 212.3 | 186.6 | 238.1 | | 66.9 | 60.8 | 73.0 | |
| | Mar | 93 | 267.1 | 240.2 | 294.0 | | 200.8 | 178.8 | 222.8 | | 65.6 | 60.5 | 70.7 | |
| | Apr | 86 | 309.7 | 277.2 | 342.2 | | 231.9 | 205.8 | 258.1 | | 75.5 | 69.1 | 81.8 | |
| | May | 87 | 334.0 | 300.1 | 367.8 | | 251.3 | 223.4 | 279.1 | | 80.3 | 74.2 | 86.3 | |
| | Jun | 90 | 321.2 | 287.5 | 354.9 | | 238.8 | 211.7 | 266.0 | | 80.5 | 74.0 | 87.0 | |
| | Jul | 93 | 319.2 | 287.8 | 350.6 | | 238.5 | 213.1 | 263.9 | | 79.3 | 73.1 | 85.5 | |
| | Aug | 90 | 322.7 | 293.2 | 352.3 | | 241.2 | 217.0 | 265.4 | | 80.2 | 74.6 | 85.8 | |
| | Sep | 90 | 297.5 | 266.0 | 329.1 | | 224.8 | 199.0 | 250.7 | | 71.4 | 65.6 | 77.3 | |
| | Oct | 93 | 312.0 | 276.4 | 347.6 | | 238.5 | 209.5 | 267.4 | | 72.4 | 65.6 | 79.2 | |
| | Nov | 90 | 274.0 | 244.2 | 303.8 | | 205.8 | 181.6 | 230.0 | | 67.1 | 61.3 | 72.9 | |
| | Dec | 83 | 266.7 | 236.6 | 296.7 | | 205.7 | 180.6 | 230.8 | | 59.6 | 54.4 | 64.9 | |
| Change of | Neither | 935 | 296.6 | 287.0 | 306.1 | 0.205 | 223.6 | 215.8 | 231.3 | 0.189 | 71.5 | 69.7 | 73.8 | 0.257 |
| month$^{i,ii}$ | First 2 days | 69 | 269.7 | 237.9 | 301.6 | | 200.1 | 174.5 | 225.7 | | 68.4 | 61.9 | 74.9 | |
| | Last 2 days | 67 | 314.7 | 271.7 | 357.8 | | 236.9 | 201.8 | 272.0 | | 76.4 | 68.4 | 84.5 | |
| Change of | Neither | 599 | 294.2 | 282.3 | 306.1 | 0.288 | 222.0 | 212.3 | 231.7 | 0.295 | 70.8 | 68.5 | 73.0 | 0.203 |
| month$^{i,ii}$ | First week | 246 | 288.1 | 269.9 | 306.2 | | 215.7 | 201.2 | 230.3 | | 70.9 | 67.2 | 74.6 | |
| | Last week | 226 | 309.1 | 288.2 | 329.1 | | 233.0 | 216.0 | 250.1 | | 74.7 | 70.7 | 78.6 | |
| Year$^{iii}$ | 2008/09 | 366 | 285.5 | 270.1 | 300.8 | 0.060 | 215.0 | 202.5 | 227.5 | 0.078 | 69.8 | 66.9 | 72.8 | 0.067 |
| | 2009/10 | 365 | 309.1 | 292.1 | 326.0 | | 233.1 | 219.4 | 246.9 | | 73.0 | 69.8 | 76.2 | |
| | 2010/11 | 364 | 309.8 | 293.5 | 326.2 | | 233.9 | 220.6 | 247.2 | | 74.9 | 71.8 | 78.1 | |

$^\$$National emergency department data are not complete for England and therefore figures do not represent national totals - see Methods. Statistics use analysis of variance. $^i$Variables exclude banks holiday and Christmas eves. $^{ii}$Change of month variables mark the first and last two days and first and last week in each month. $^{iii}$Years run 31$^{st}$ March to 30$^{th}$ March to account for time-shifted data.

**Table 3 Generalised linear model examining independent impacts of calendar events on mean numbers of assault presentations per night to emergency department services in England**

| Variable | | Slope (B) | 95%CIs | | P |
|---|---|---|---|---|---|
| Months | January | −31.22 | −44.88 | −17.56 | <0.001 |
| | February | 13.64 | −0.69 | 27.98 | 0.062 |
| | March | 6.14 | −7.76 | 20.03 | 0.387 |
| | April | 41.02 | 27.18 | 54.86 | <0.001 |
| | May | 52.44 | 38.61 | 66.27 | <0.001 |
| | June | 46.99 | 33.04 | 60.93 | <0.001 |
| | July | 51.03 | 37.35 | 64.70 | <0.001 |
| | August | 59.88 | 45.53 | 74.24 | <0.001 |
| | September | 36.54 | 22.75 | 50.32 | <0.001 |
| | October | 31.11 | 17.32 | 44.90 | <0.001 |
| | November | 6.43 | −7.47 | 20.34 | 0.365 |
| | December (Ref) | | | | |
| Weekends & | Fri-Sat | 303.13 | 296.84 | 309.42 | <0.001 |
| Holidays | Bank Holiday Eves Sun-Thur | 242.74 | 221.55 | 263.94 | <0.001 |
| | New Year's Eve Sun-Thur | 970.35 | 904.72 | 1035.98 | <0.001 |
| | Bank Holiday Eves Fri-Sat | 275.85 | 183.57 | 368.13 | <0.001 |
| | New Year's Eve Fri-Sat | 1107.85 | 1015.57 | 1200.13 | <0.001 |
| | Sun-Thur (Ref) | | | | |
| [i]Sporting | FA Cup final | 53.62 | −0.45 | 107.68 | 0.052 |
| Events | Six Nations Rugby | 7.65 | −18.41 | 33.72 | 0.565 |
| | World Cup Football England | 298.05 | 251.10 | 344.99 | <0.001 |
| | Olympics | −38.07 | −62.70 | −13.44 | 0.002 |
| | UEFA Champions final | 32.03 | −21.86 | 85.92 | 0.244 |
| [i]Celebrations | St Patrick's day | 65.38 | 11.49 | 119.26 | 0.017 |
| | Halloween | 191.99 | 138.10 | 245.88 | <0.001 |
| | Valentine's day | −12.61 | −68.61 | 43.40 | 0.659 |
| | Guy Fawkes night | 96.37 | 42.50 | 150.24 | <0.001 |
| | St George's day | 7.45 | −46.43 | 61.33 | 0.786 |

[i] Sporting events and celebrations are all entered into the generalised linear model as separate binary variables. Reference categories have been omitted. Data cover the time period 31st March 2008 to 30th March 2011 (see Methods). 95%CI = 95% confidence intervals. Full details of calendar events, sporting events and celebrations are given in Table 1.

2008 Olympics were associated with a small but significant fall in assault presentations and this effect was maintained even when GLM analysis was limited to 2008 ($X^2 = 5.733$; P < 0.05). The overall calendar model (Table 3) including night of the week, holiday eves, celebrations, and sporting events was a strong predictor of observed values (observed *v* modelled estimates; $R^2 = 0.918$; P < 0.001).

**Sex and deprivation effects**

Numbers of assault presentations were significantly higher for males than for females (Table 2; t = 50.84, P < 0.001). Male to female assaults ratios were highest on peak days for assaults; increasing from a mean of 2.76 (95% CIs 2.72-2.80) on Sunday-Thursday nights to 3.64 (95% CIs 3.59-3.69) on Friday-Saturday nights (t = 24.40; P < 0.001), and further to 4.14 (95% CIs 3.86-4.43) on New Year's Eve. Examining assaults by deprivation identified that the proportion of assault presentations on Sunday-Thursday nights increased with deprivation (most affluent to most deprived quintile, 46.02%, 47.21%, 49.49%, 51.41% & 54.23%; $X^2_{trend} = 1065.22$, P < 0.001). LR analysis examined the individual contribution of age, sex, and deprivation to likelihood of presenting in the ED for a nighttime assault (Figure 2). Risks peaked strongly at age 18 years. Odds of assault presentation were more than three times higher for males (3.14, 95% CIs 3.11-3.16; P < 0.001) than for females and nearly four times greater for the most deprived quintile than the most affluent (3.87, 95% CIs 3.82-3.92; P < 0.001).
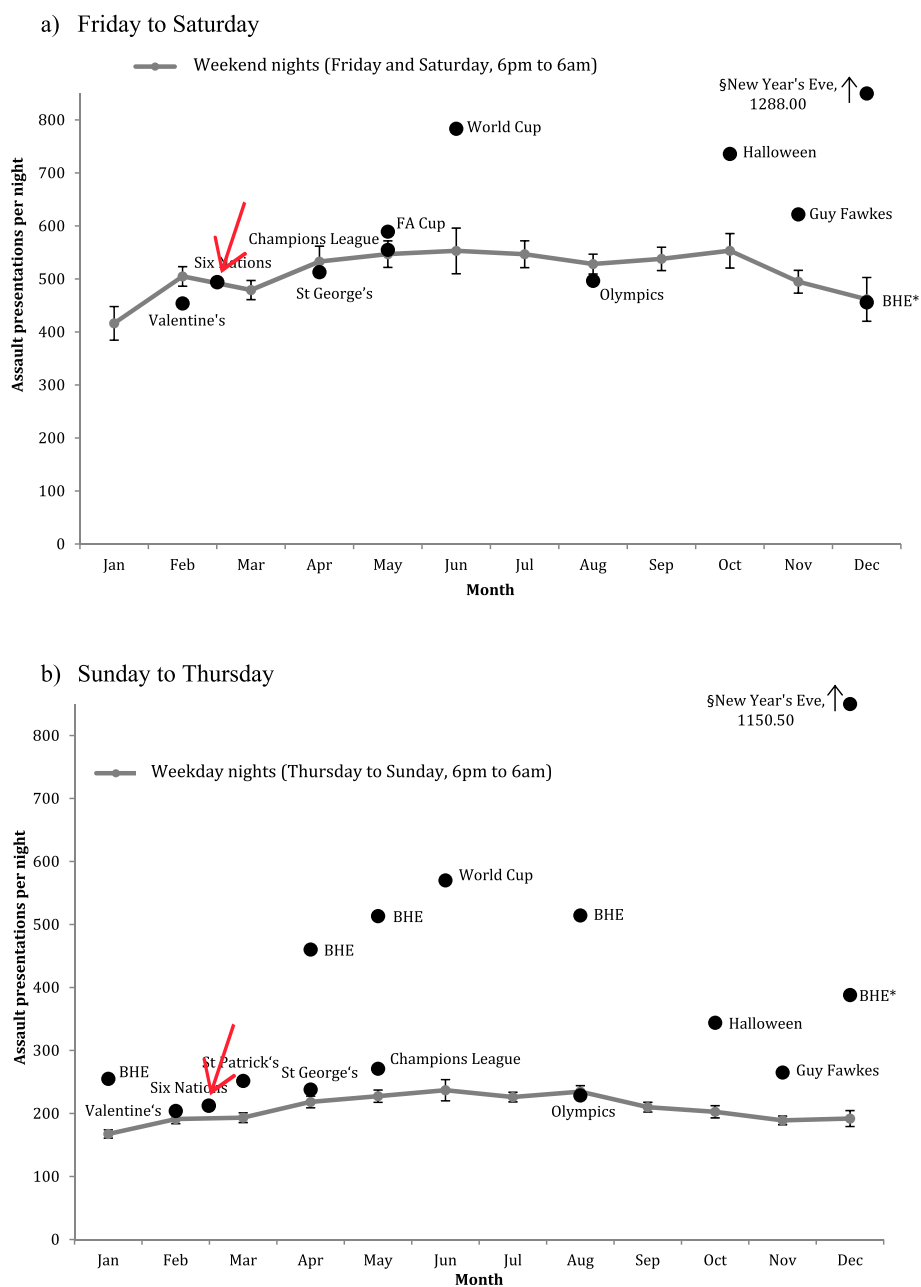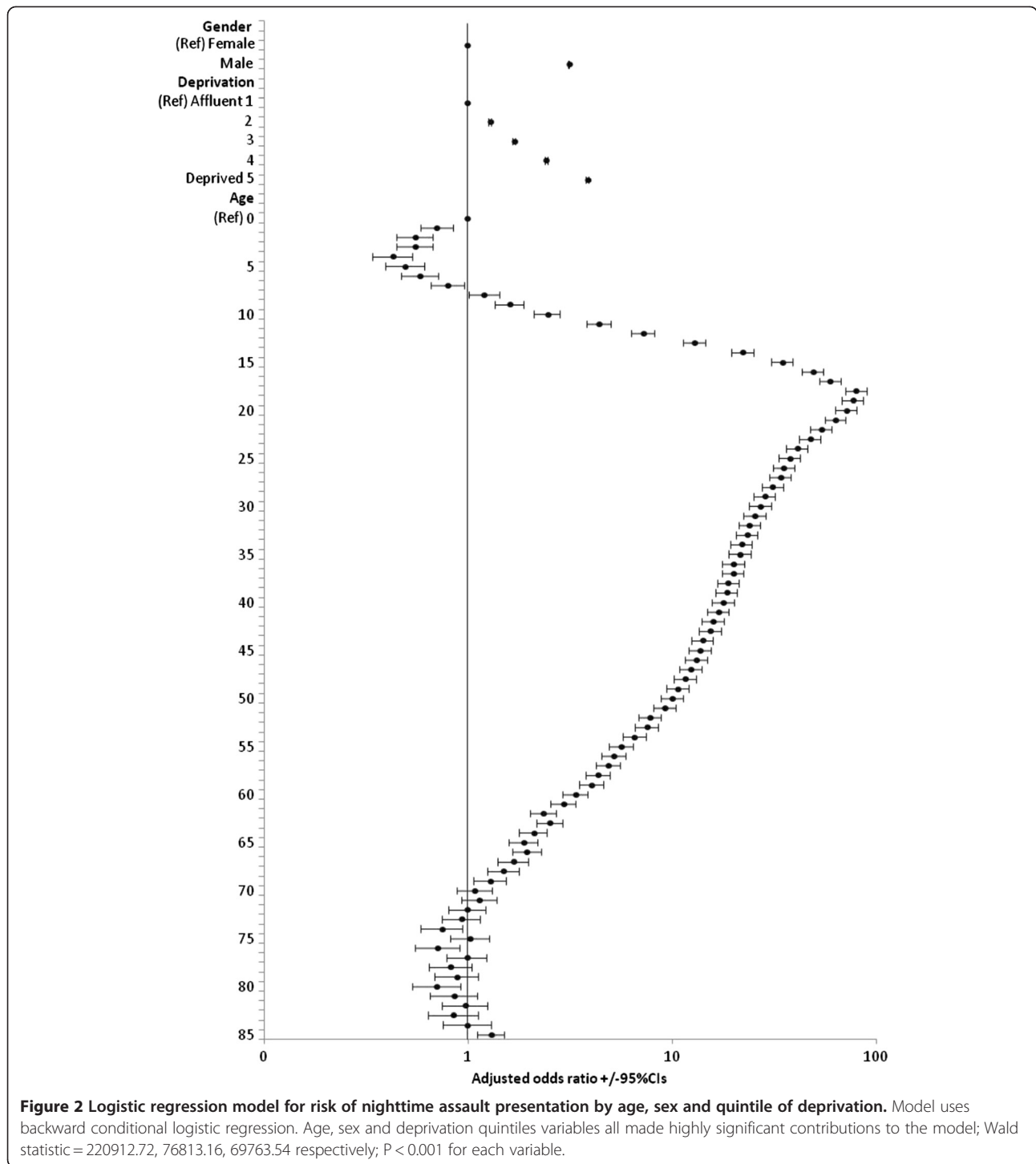
**Figure 1 Mean assault presentations per night by month and for holidays, sporting events, or other celebrations; a) Friday and Saturday nights; b) Sunday to Thursday nights.** 95% confidence intervals are presented for each month only. For statistical significance of differences see Table 3. Full descriptions of the holidays, sporting events, and celebrations included are given in Table 1. BHE = Bank holiday eve; § New Year's Eve has mean value provided as it is outside the y axis scale.

In order to examine how the impact of deprivation varies with age, deprivation rate ratios (DRRs; rate in most deprived quintile/most affluent quintile) were calculated (Figure 3a,b). DRRs in males showed a pre-pubescent peak around age six years, a nadir at 21 years then an increase to a post-adolescence plateau from approximately 45 years (Figure 3a). Variations in DRRs in females were similar to males. However, both the pre-pubescent rise and post-adolescence plateau were less well defined than for males (Figure 3b). Year wise paired comparison of DRRs between males and females identified no significant difference (t = 0.688, P = 0.493).

## Discussion

We have demonstrated that a national ED monitoring system can usefully identify individual and community

**Figure 2 Logistic regression model for risk of nighttime assault presentation by age, sex and quintile of deprivation.** Model uses backward conditional logistic regression. Age, sex and deprivation quintiles variables all made highly significant contributions to the model; Wald statistic = 220912.72, 76813.16, 69763.54 respectively; P < 0.001 for each variable.

risk factors for assault and changes in service pressures with calendar, celebration, and sporting events. Routine analyses of assault data often uses police recorded crime to examine the impact of calendar events on assaults. However, such data can be confounded by both levels of police activity (number of individuals working in any area), policing policy (e.g.,

which violent events warrant warning and which arrests) and where they take place (e.g., detection of assaults in public vs. private spaces). ED data are not directly impacted by such confounders, provide a measure of health harms relating to nighttime assaults and include events that are not reported to police [11].
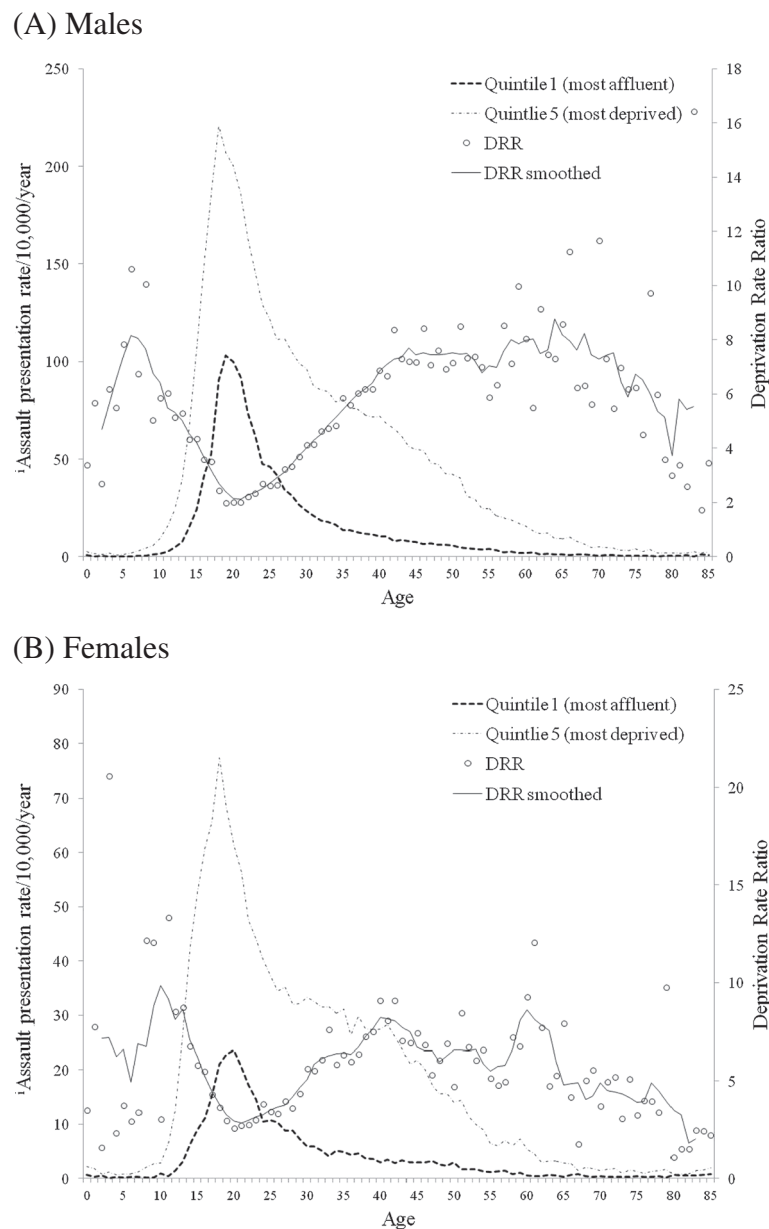
**Figure 3 Affluent and deprived quintile assault presentation rates[i] and deprivation rate ratios by age.** DRR = deprivation rate ratio. DRR smoothed is calculated as a five year rolling average. [i]Not all ED services currently report violence data to the national database and therefore these are presented only for comparative purposes.

Using such ED data this study identifies that nights preceding work-free days see more than double levels of assaults presentations (Figure 1a, b). Assault levels peak in summer months falling to a low in January (Figure 1a, b; Table 3), when alcohol consumption can also reach its nadir [39]. Although violence has been linked with warmer weather [40], a concentration of individuals' personal holidays in the summer period may also be a contributing factor despite many individuals holidaying abroad [41]. Constraints that employment places on the length of nights out and alcohol consumption are

removed not only by holidays but also by unemployment [42]. Thus, the most deprived communities showed the highest assault rates and a greater proportion of assaults on Sunday-Thursday nights; consistent with more individuals having no employment pressures midweek. Further, while deprived and affluent males both showed peaks in assaults rates in their late teens, rates reduced more rapidly in the most affluent (Figure 3a). Movement into employment in post-adolescence can reduce excessive alcohol use [43] – although how this impacts on exposure to violence is less well studied. We also identified

deprivation-related differences in assault presentation at early ages. Critically, by age 15 years males in the most deprived quintile had exceeded the peak presentation level achieved in the most affluent quintile at age 19 years (Figure 3a). Worse, for females assault presentations in the affluent quintile peaked at age 20 years and rates in the most deprived quintile exceeded this peak by age 13 years (Figure 3b).

Globally, social inequality, poverty and youth unemployment have been associated with increased violence [44] and even rioting in some countries, including the UK [45]. Internationally, attention has focused on both immediate policing measures to prevent further violence and, increasingly, the need for longer-term multidisciplinary life course approaches to improve young people's prospects and reduce their overall propensity for violence [1,17,46,47]. On the former, some local ED data systems have already been used to record assault location and inform the targeting of police activity [11-13] often in nightlife areas. On the latter however, potential roles for ED data remain largely underdeveloped. Results presented here identify a much earlier escalation in violence in the poorest communities and a peak at a much higher level (Figure 3a,b). Early life exposure to violence represents a direct risk to children's immediate and long-term physical and mental health [48,49]; in some circumstances resulting in permanent disability. Moreover, such exposure also leaves individuals more likely to engage in violence later in adolescence and adulthood [48,50]. Early life exposure to assaults can be reduced through parental support, preschool enrichment, and social development programmes [16-19]. Several of these programmes, such as Nurse Family Partnerships [16], have already begun to be scaled up in a number of countries including Canada [51], Australia [52] and England [53]. Here we have identified how a national ED data system can provide a benchmark; identifying areas most in need of such interventions.

As well as a role in targeted long-term prevention, we have shown that a national ED data system identifies peaks and troughs in violence that are strongly associated with events such as celebrations and sporting events. In England Halloween, Guy Fawkes Night and St Patrick's Day are now heavily commercialised events with themed alcohol promotions, organised public events (such as club nights and bar crawls) and private parties. All three were associated with significant increases in assaults (Figure 1a,b; Table 3). However, Valentine's Day and St George's Day showed no significant increases. Sporting events also varied in impact on assault presentations. Presentations increased dramatically on nights when the national team played in the World Cup but not with other football or rugby fixtures

(Figure 1a,b; Table 3). The association between sport and public violence has been examined elsewhere [54,55]. However, this study identifies how ED data can measure the impacts of violence beyond that typically observed around city centres and gatherings such as sporting events. Thus, broadcast access to the Beijing Olympics was associated with a small but significant reduction in overall assault presentations in England (Table 3). While understanding such patterns exposes expected pressures on ED departments, they are also pertinent to other frontline services such as ambulance and police. Currently, there is little information on how well emergency staffing levels are attuned to demand and national ED data, with local intelligence, could help inform the efficient distribution of staff and other resources on a calendar basis.

Our analysis only examined public holidays, national celebrations, and some major national and international sporting events. In planning holidays and events nationally more thought should be given to how selection of specific times, days, and months could be used to minimise any resultant increase in violence. Moreover, health and other agencies should consider such intelligence when timing campaigns to reduce binge drinking and related violence, stipulating license requirements, and enforcing critical legislation (for example, no sales of alcohol to those underage or already drunk).

The ability of ED data to provide intelligence on nighttime assaults relies on individuals reporting violence as the reason for their presentation. Such reporting may be affected by issues of confidentiality. More work is required on protecting confidentiality by establishing optimal levels of data access for different organisations and at different geographical levels [56]. While some local ED systems in England collect and share information on assault location, few share information on residence; despite this being routinely collected in the ED services. This combination of data is urgently needed to understand trends in and relationships between public (e.g., city centre) and private space (e.g., homes) violence. Together, these data would enable an effective multiagency response both nationally and locally. However, even the experimental data utilised here exposes some important gaps in our understanding of nighttime violence. Thus, some events are violence promoters (such as St Patrick's Day and England games in the football World Cup), while others are nonbelligerent (such as St George's Day and the Rugby Six Nations) or perhaps even protective (for example, the Olympics). The relative impact of different holidays and events may vary with locality and nation. For example in Cardiff, Wales (where rugby is often considered to be the national sport), international rugby matches involving the Welsh team have been associated with increased ED assault attendances [55]. Research is needed to understand the factors

protecting relatively peaceful celebrations, and the roles commercialisation and linkage with alcohol promotions play in coupling celebrations with violence.

This study has a number of important limitations. English national HES A&E data are still incomplete. Although a full audit of data quality is not available, comparison with the QMAE suggests HES A&E represent 74% of all presentations regardless of cause [28]. HES A&E though covers all major EDs with much missing data arising from other emergency service providers such as walk in centres, which only accounted for 1.2% of nighttime assault presentations in this dataset. However, although emergency services are the principal resource for urgent assault treatment at night not all individuals assaulted, or even requiring treatment will present to them. England also has a general practice on call system where doctors can be asked to attend individuals' places of residence. Further, injured individuals may also attempt to treat themselves or to delay treatment until the next day when there is a greater range of treatment options and their attendance time may fall outside of this study's inclusion criteria. The study cannot quantify how frequently such options are exploited by those injured in assaults; although they are unlikely to be options for those requiring immediate attention.

In ED data, reason for attendance was coded as unknown in 4.7% of cases but data coding relies on patients revealing that their injuries have been sustained through violence and this being accurately coded in busy EDs. Although the absence of any violence related presentations from nine providers suggests under-recording of assaults, currently it is not possible to quantify the scale of such miscoding across all EDs. These issues will inevitably affect any calculation of rates. However, our findings focus on comparative risks; largely between different days or different demographics. We are not aware of any calendar, deprivation, or age/sex related bias in missing data that could confound our results, although this cannot be entirely discounted. Our focus has been on levels of emergency presentations for assault and therefore we have excluded ED attendances for follow ups relating to a previous ED attendance. We have not attempted to remove multiple presentations by the same individual for different assaults (see methods). Consequently, demographic analyses relate to probabilities of presentations being from a particular demographic. However, across the three-year study period only 6.7% of individuals presented for nighttime assault more than once and analysis of individuals, rather than presentations, would be unlikely to substantively affect results.

Sporting events included were a convenience selection based on those best known and highly promoted. There are a wide range of other local events that might have been included in this analysis and the impact of even national events (such as a football cup final) may vary with

locality; if, for instance, a local team are involved. The analyses undertaken should be considered a proof of concept for the utility of ED data, which could be implemented much more widely with a complete national data set. We could not distinguish assault locations (e.g., home or city centre bar), and thus we have made no assumptions about whether assaults took place in public places or private residences. While the national ED system does not currently collect location of assault, the collection and sharing of such data at local level is increasing [11,12,57]. Finally, while this study has examined the utility of a national ED dataset in measuring calendar and demographic risk factors for nighttime assaults further analyses are now possible. ED data allows additional exploration of the residence of those involved in violence (e.g., by population density, urban vs. rural locality, etc.). Data on alcohol consumption by those presenting to EDs is not currently available nationally but, routinely collected even from a subset of EDs, could provide important intelligence on the impact of alcohol on nightlife assaults [11].

## Conclusions

Globally, national routine data collection from EDs is rare. However, it provides novel intelligence for public health. A national perspective helps avoid displacement issues [58] when assessing whether violence levels have fallen or simply moved elsewhere (e.g. a neighbouring city). ED data on nighttime assaults provide residence information and consequently, measures of socio-economic status (e.g., IMD) as well as the ability to apply population denominators for identification of rates and risk factors (e.g., by age and sex).

Risk of involvement in violence is a composite of at least environment (e.g., city centre management, access to alcohol), other proximal factors specific to the individual (e.g., employment status), and a propensity for violence that can be rooted in early childhood experiences. In these respects it has the same complex origins as other major threats to health such as obesity [59]. However, until recently the role of health services in the prevention of violence has been largely passive; with active elements limited to dealing with the physical and mental health consequences of assaults and abuse. Use of ED data, for instance, has often focused on helping target police and other regulatory activity rather than been considered as a tool to direct health interventions. This study shows how ED data might be utilised to inform frontline responses, including by EDs themselves. More importantly however, it should be central to a multiagency life course approach to the prevention of violence. A national ED system can describe the problem, identify risk and protective factors, and target prevention and protection interventions as well as assess their impact. While criminal justice systems work to contain a culture where celebrations, sports events, and holidays lead to greater violence,

health services could help create one where they are not inextricably linked.

## Abbreviations
AOR: Adjusted odds ratio; CIs: Confidence intervals; DRR: Deprivation rate ratio; ED: Emergency department; GLM: Generalised linear modelling; HES: Hospital Episode Statistics; IMD: Index of Multiple Deprivation; LR: Logistic regression; LSOA: Lower super output area.

## Competing interests
The authors declare that they have no competing interests.

## Authors' contributions
MAB designed the study and oversaw its implementation. NL, SW, ZQ undertook the data extraction, formatting and quality assurance. MAB, KH and NL analysed the data. All authors contributed to the writing of the manuscript, reviewed the study findings, read and approved the final version before submission. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. MAB is the study guarantor. All authors read and approved the final manuscript.

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## References
1. Krug EG, Dahlberg LL, Mercy JA, Zwi AB, Lozano R: *World report on violence and health*. Geneva: World Health Organization; 2002.
2. World Health Organization: *Global burden of disease: disease and injury regional mortality estimates for 2008*; http://www.who.int/healthinfo/global_burden_disease/estimates_regional/en/index.html.
3. Butchart A, Brown D, Khanh-Huynh A, Corso P, Florquin N, Muggah R: *Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence*. Geneva: World Health Organization; 2008.
4. Chaplin R, Flatley J, Smith K: *Crime in England and Wales 2010/11*. London: Home Office; 2011.
5. Dubourg R, Hamed J: *Estimates of the economic and social costs of crime in England and Wales: costs of crime against individuals and households, 2003/04*. London: Home Office; 2005.
6. NHS Security Management Services: *Cost of violence against NHS staff*. London: NHS Security Management Services; 2010.
7. Krug EG: **Injury surveillance is key to preventing injuries.** *Lancet* 2004, **364**:1563–1566.
8. Holder Y, Peden M, Krug EG, Lund J, Gururaj G, Kobusingye O: *Injury surveillance guidelines*. Geneva: World Health Organization; 2001.
9. Sutherland I, Sivarajasingham V, Shepherd J: **Recording of community violence by medical and police services.** *Inj Prev* 2002, **8**:246–247.
10. Brink O: **The epidemiology of violence in Denmark.** *J Clin Forensic Med* 1998, **5**:38–44.
11. Quigg Z, Hughes K, Bellis MA: **Data sharing for prevention: a case study in the development of a comprehensive emergency department injury surveillance system and its use in preventing violence and alcohol-related harms.** *Inj Prev* 2011, doi:10.1136/injuryprev-2011-040159.
12. Florence C, Shepherd J, Brennan I, Simon T: **Effectiveness of anonymised information sharing and use in health service, police, and local government partnership for preventing violence related injury: experimental study and time series analysis.** *BMJ* 2011, **342**:d3313.
13. Ward E, Durant T, Thompson M, Gordon G, Mitchell W, Ashley D, The VRISS: **Implementing a hospital-based violence-related surveillance system - a background to the Jamaican experience.** *Inj Contr Saf Promot* 2002, **9**:241–247.
14. Sklaver BA, Clavel-Arcas C, Fandino-Losada A, Guitierrez-Martinez MI, Rocha-Castillo J, de Garcia SM, Concha-Eastman A: **The establishment of injury surveillance systems in Colombia, El Salvador, and Nicaragua (2000–2006).** *Rev Panam Salud Publica* 2008, **24**:379–389.
15. Wahl RA, Sisk DJ, Ball TM: **Clinic-based screening for domestic violence: use of a child safety questionnaire.** *BMC Med* 2004, **2**:25.
16. Eckenrode J, Campa M, Luckey DW, Henderson CR Jr, Cole R, Kitzman H, Anson E, Sidora-Arcoleo K, Powers J, Olds D: **Long-term effects of prenatal and infancy nurse home visitation on the life course of youths: 19-year follow-up of a randomized trial.** *Arch Pediatr Adolesc Med* 2010, **164**:9–15.
17. World Health Organization & Centre for Public Health Liverpool John Moores University: *Violence prevention: the evidence*. Geneva: World Health Organization; 2010.
18. Reynolds AJ, Temple JA, Ou S-R, Robertson DL, Mersky JP, Topitzes JW, Niles MD: **Effects of a school-based, early childhood intervention on adult health and well-being.** *Arch Pediatr Adolesc Med* 2007, **161**:730–739.
19. Prinz RJ, Sanders MR, Shapiro CJ, Whitaker DJ, Lutzker JR: **Population-based prevention of child maltreatment: the U.S. Triple P system population trial.** *Prev Sci* 2009, **10**:1–12.
20. Koegl CJ, Farrington DP, Augimeri LK, Day DM: **Evaluation of a targeted cognitive-behavioral program for children with conduct problems - the SNAP under 12 outreach project: service intensity, age and gender effects on short- and long-term outcomes.** *Clin Child Psychol Psychiatry* 2008, **13**:419–434.
21. Bellis MA, Hughes K, Anderson Z, Tocque K, Hughes S: **Contribution of violence to health inequalities in England: demographics and trends in emergency hospital admissions for assault.** *J Epidemiol Community Health* 2008, **62**:1064–1071.
22. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M: **The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis.** *Lancet* 2009, **9686**:315–323.
23. Gagg J: **Effect of the royal wedding on emergency department attendance.** *Emerg Med J* 2011, **28**:902–903.
24. Enock KE, Jacobs J: **The Olympic and paralympic games 2012: literature review of the logistical planning and operational challenges for public health.** *Public Health* 2008, **122**:1229–1238.
25. Jones LA, Goodacre S: **Effect of 24-h alcohol licensing on emergency departments: the South Yorkshire experience.** *Emerg Med J* 2010, **27**:688–691.
26. Owens PL, Barrett ML, Gibson TB, Andrews RM, Weinick RM, Mutter RL: **Emergency department care in the United States: a profile of national data sources.** *Ann Emerg Med* 2010, **56**:150–165.
27. Meerding WJ, Polinder S, Lyons RA, Petridou ET, Toet H, van Beeck EF, Mulder S: **How adequate are emergency department home and leisure injury surveillance systems for cross-country comparisons in Europe?** *Int J Inj Contr Saf Promot* 2010, **17**:13–22.
28. NHS Information Centre for Health and Social Care: *Accident and Emergency Attendances in England (experimental statistics):* ; 2010–2011. http://www.ic.nhs.uk/statistics-and-data-collections/hospital-care/accident-and-emergency-hospital-episode-statistics-hes.
29. *The Information Centre for Health and Social Care. Secondary Uses Service (SUS)*; http://www.ic.nhs.uk/services/secondary-uses-service-sus.
30. *The Information Centre for Health and Social Care. HES online*; www.hesonline.nhs.uk.
31. Bates A: **Methodology used for producing ONS's small area population estimates.** *Popul Trends* 2006, **125**:30–36.
32. Noble M, McLennon D, Wilkinson K, Whitworth A, Barnes H, Dibben C: *The English Indices of Deprivation 2007*. London: Communities and Local Government; 2008.
33. Bellis MA, Hughes K, Wood S, Wyke S, Perkins C: **National five-year examination of inequalities and trends in emergency hospital admission for violence across England.** *Inj Prev* 2011, **17**:319–325.
34. Hosmer DW, Lemeshow S: *Applied logistic regression (2nd edition)*. Hoboken, NJ: John Wiley & Sons, Inc; 2000.
35. Gagnon DR, Doron-LaMarca S, Bell M, O'Farrell TJ, Taft CT: **Poisson regression for modelling count and frequency outcomes in trauma research.** *J Trauma Stress* 2008, **21**:448–454.
36. NHS Information Centre for Health and Social Care: *The HES Protocol (June 2009)*. Leeds:; 2009 http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=331.
37. Nelson AL, Bromley RDF, Thomas CJ: **Identifying micro-spatial and temporal patterns of violent crime and disorder in the British city centre.** *Appl Geogr* 2001, **21**:249–274.

38. Cusimano M, Marshall S, Rinner C, Jiang D, Chipman M: **Patterns of urban violent injury: a spatio-temporal analysis.** *PLoS One* 2010, **5**:e8669.
39. Sheen D, Tettenborn M: *British beer & Pub association statistical handbook 2010.* London: British Beer & Pub Association; 2011.
40. Horrocks J, Menclova AK: **The effects of weather on crime.** *New Zeal Econ Pap* 2011, **45**:231–254.
41. Hughes K, Bellis MA, Calafat A, Juan M, Schnitzer S, Anderson Z: **Predictors of violence in young tourists: a comparative study of British, German and Spanish holidaymakers.** *Eur J Public Health* 2008, **18**:569–574.
42. Dávalos ME, Fang H, French MT: **Easing the pain of an economic downturn: macroeconomic conditions and excessive alcohol consumption.** *Health Econ* 2011, doi:10.1002/hec.1788.
43. Bachman JG, O'Malley PM, Shchulenberg JE, Johnston LD, Bryant AL, Merline A, Bachman JG, O'Malley PM, Shchulenberg JE, Johnston LD, Bryant AL, Merline AC: *The decline of substance use in young adulthood: changes in social activities, roles, and beliefs.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc; 2002.
44. Briceno-Leon R, Villaveces A, Concha-Eastman A: **Understanding the uneven distribution of the incidence of homicide in Latin America.** *Int J Epidemiol* 2008, **37**:751–757.
45. Riots Communities and Victims Panel: *After the riots.* London: Riots Communities and Victims Panel; 2012.
46. Government HM: *Ending gang and youth violence: a cross-government report.* Norwich: The Stationery Office; 2011.
47. Matzopoulos R, Bowman B, Mathews S, Myers J: **Applying upstream interventions for interpersonal violence prevention: an uphill struggle in low- to middle-income contexts.** *Health Policy* 2010, **97**:62–70.
48. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, Dube SR, Giles SW: **The enduring effects of abuse and related adverse experiences in childhood. A convergence of evidence from neurobiology and epidemiology.** *Eur Arch Psychiatry Clin Neurosci* 2005, **256**:174–186.
49. Felitti VJ, Anda RF, Nordenberg D, Wiliamson DF, Spitz AM, Edwards V, Koss MP, Marks JS: **Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study.** *Am J Prev Med* 1998, **14**:245–258.
50. Duke NN, Pettingell SL, McMorris BJ, Borowsky IW: **Adolescent violence perpetration: associations with multiple type of adverse childhood experiences.** *Pediatrics* 2010, **125**:778–786.
51. Canadian Nurse-Family Partnership ; http://nfpmcmasterca/indexphp.
52. Australian Nurse-Family Partnership Program ; http://wwwanfppcomau/.
53. Barnes J, Ball M, Meadows P, Howden B, Jackson A, Henderson J, Niven L: *The family-nurse partnership programme in England: wave 1 implementation in toddlerhood & a comparison between waves 1 and 2a of implementation in pregnancy and infancy.* London: Department of Health; 2011.
54. Quigg Z, Hughes K, Bellis MA: **Effects of the 2010 world Cup football tournament on emergency department assault attendances in England.** *Eur J Public Health* 2012, doi:10.1093/eurpub/cks098.
55. Sivarajasingham V, Moore S, Shepherd J: **Winning, losing, and violence.** *Inj Prev* 2005, **11**:69–70.
56. Hirshon JM, Warner M, Irvin CB, Nixka RW, Andersen DA, Smith GS, McCaig LF: **Research using emergency department-related data sets: current status and future directions.** *Acad Emerg Med* 2009, **16**:1103–1109.
57. Stephenson J: **DH orders audit of A&E information sharing on violent crime.** *Nurs Times* 2012, **108**(17):4.
58. Bowers K, Johnson S, Guerette RT, Summers L, Poynton S: **Spatial displacement and diffusion of benefits among geographically focused policing initiatives.** *Campbell Systematic Reviews* 2011, **3**. doi:10.4073/csr.2011.3.
59. Parsons TJ, Power C, Logan S, Summerbell CD: **Childhood predictors of adult obesity: a systematic review.** *Int J Obes Relat Matab Disord* 1999, **23**(Suppl8):S1–S107.

*Article*

# Drunk and Disorganised: Relationships between Bar Characteristics and Customer Intoxication in European Drinking Environments

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**Abstract:** Preventing alcohol-related harm in drinking environments is a growing international priority. Factors relating to the physical, social and staffing environments in bars can contribute to increased alcohol consumption and harm. Understanding the relationships between such factors and intoxication in European drinking environments is critical to developing appropriate interventions. We undertook a quantitative observational study in 60 bars in four European cities, in The Netherlands, Slovenia, Spain and the UK (n = 237 observational visits). Using a structured observational schedule, researchers recorded characteristics of the bar environment and rated customer intoxication levels. All physical bar characteristics showed associations with intoxication before interactions between them were controlled for. Hierarchical modelling found significant independent associations between intoxication and use of plastic glassware, promotion of non-alcoholic

drinks (often energy drinks), permissive environments, poor washroom facilities, the presence of a dance floor, customer sexual activity/competitiveness and later observational time. Findings suggest that prevention efforts should focus on raising and enforcing managerial standards in bars. While harm reduction measures such as plastic glassware are often promoted for high risk bars, such measures are inadequate to address public health concerns and insufficient to demonstrate social responsibility.

## 1. Introduction

Preventing alcohol-related harm in drinking environments is a growing international priority. The World Health Organization's global alcohol strategy [1] identifies drinking environments as key settings for interventions to reduce the negative consequences of alcohol. Suggested policy options include measures to regulate drinking contexts to minimise harm and implement management policies regarding responsible beverage service. Equally, the European alcohol action plan [2] recognises the importance of bar environments in increasing or preventing alcohol-related problems, and suggests the development of guidelines and standards for the design of drinking premises, server training and the monitoring and enforcement of licensing laws. This focus on drinking environments is backed up by a strong body of research showing that high levels of alcohol use and related problems occur in and around bars and nightclubs [3–6]. Binge drinking and intoxication are common among nightlife users [7], and studies consistently associate higher densities of drinking premises with greater alcohol-related harm, particularly violence [8–10]. The presence of intoxicated customers in bars increases risks of such harm [11–13], highlighting the need for prevention measures to focus on reducing intoxication [13].

Alcohol-related harm is often concentrated in specific problematic venues [14]. This can relate to management choices in such venues, including those around bar design, staff practice, entertainment provision and type of clientele targeted [15,16]. Recognition of the importance of bar environments in promoting or preventing alcohol-related problems has driven research to identify characteristics of bars that can contribute to alcohol-related harm [15,17–19]; and consequently that can be moderated to prevent harm [11]. A review of these studies identified numerous factors that have emerged as important in predicting greater alcohol use and harm, including poor cleanliness, crowding, loud music, and a permissive environment (*i.e.*, tolerance towards anti-social behaviour) [20]. However, most studies identified had been conducted in non-European settings, and most had focused on alcohol-related harm rather than intoxication. Thus, there is currently a lack of knowledge to inform the development of venue-focused interventions in European drinking environments. To address this gap, we undertook a quantitative observational study in youth-oriented bars in four European cities.

## 2. Methods

The study took place in Utrecht (the Netherlands), Ljubljana (Slovenia), Palma de Mallorca (Spain) and Liverpool (UK) (for further information on each city see [7]). In each city, 15 venues popular with young people were identified for inclusion in the study, providing a sample of 60 venues. Two

strategies were used to identify venues. In Liverpool, Ljubljana and Utrecht, researchers liaised with relevant authorities to identify all youth-focused bars and categorise these into low, medium or high risk premises based on local data/knowledge of alcohol-related harm. From each group, five premises were randomly selected for the study. In Palma, low, medium and high risk venues were selected based on consultation with local nightlife users.

The observation schedule used to assess premises and the implementation method was based on that developed by Graham *et al*. [17]. The schedule comprised a range of scale variables and other questions designed to measure aspects of the bar environment (see Appendix Table A1). The original schedule was altered slightly following a research meeting to tailor it to contemporary bar environments in Europe; some items were removed (e.g., pool table atmosphere) and some added (e.g., the price of certain drinks). Research leads from each country undertook a training session to develop consistency in implementing the observational visits, completing the schedule and recognizing and rating intoxication. For the latter, focus was placed on observational indicators that researchers could use to recognise different stages of intoxication, including changes in drinkers' behaviour, appearance and coordination. The training also included a test bar observation, with research leads completing the schedule independently after the visit and comparing and discussing ratings at a meeting the following day. Each research lead then recruited field researchers in their country and repeated the training programme.

In each city, covert one-hour observational visits were undertaken to each venue during peak opening hours on four separate occasions, with days and times of visits varied for each venue. Each observational visit was conducted by a mixed gender pair. Observations took place on Thursday, Friday and Saturday nights (September to December 2010) between 10 p.m. and 5 a.m., with study timings dependent upon local nightlife activity. In Utrecht, researchers were unable to undertake a fourth visit to two premises. Thus, 238 observational visits were undertaken. During observations, researchers were instructed to position themselves in areas with good visibility and to move around to ensure they observed all parts of the venue. They were requested to: behave as customers (being permitted to consume one alcoholic drink); dress in clothing appropriate to the venue; remain as inconspicuous as possible; and avoid unnecessary interaction with other customers. Covert note taking was permitted on mobile phones. Following each visit, researchers independently completed the observational schedule. Paired schedules were later checked at a research meeting with fieldworkers and research leads, with differences between the two schedules discussed and consensus met. Thus, each observation resulted in a single completed schedule. Ethical approval for the study was obtained from Liverpool John Moores University research ethics committee in the UK.

Analysis used SPSS version 17. The primary dependent variable was "intoxication level of people in the venue", measured on a scale of 0 (no sign of intoxication) to 9 (everyone is drunk). This scale had not been completed for one observation in Utrecht and this visit was excluded from analysis (n = 237 visits). For environmental characteristics, measures that used a 0–9 scale were entered as continuous variables with most other data items dichotomised into categorical variables (see Appendix Table A1). Two measures recorded as percentages (customers dancing, seating) were converted into scale variables (see Appendix Table A1). Data completeness was high across all variables (>98% with the exception of individual drink prices; 98% of visits provided at least one drink price and 67%

provided all four drink prices). Missing values were imputed as the city mean for scale variables or the venue norm for dichotomous variables.

Bars can vary their operation at different times and consequently each visit was used as a separate observation in analysis rather than an average being calculated for a venue. City level comparisons of environmental characteristics recorded at each visit used chi squared and ANOVA. For multivariate analysis, scale variables that were highly correlated (r > 0.50) were combined in composite scales (see Appendix Table A1). Analysis used hierarchical modelling (linear mixed modelling) with venue as the unit of observation. All variables were initially input individually to identify associations with intoxication. Variables were then entered into six separate multivariate models relating to: (1) venue entrance; (2) physical environment; (3) bar activities; (4) alcohol and food service; (5) venue staff; and (6) customer factors. Five additional contextual variables were analysed: city; observation time (an equal split between earlier/later observations in each city); number of customers in the premise (>100 or not at the busiest time); whether police were outside the venue during the observation (which may have affected staff/customer behaviour); and whether the venue had an outdoor drinking area. Variables with independent relationships with intoxication ratings within each model were entered into the final models.

## 3. Results

Tables 1 and 2 show the distribution of environmental characteristics recorded during observational visits by city. There were significant differences between cities for most characteristics. For example, door staff were present during fewer observational visits in Ljubljana than in other cities, while alcoholic drink promotions were most commonly seen in Liverpool (Table 1). Observers in Utrecht recorded the highest mean rating on the cleanliness scale (*i.e.*, lower levels of cleanliness). In Palma, most observations identified high alcohol content drinks (predominantly spirits) to be the dominant drink types consumed, whereas in Utrecht low alcohol content drinks (e.g., lager) dominated. Table 1 shows the mean prices of drinks purchased across cities. The mean price of a bottle of lager, for example, ranged from €2.28 in Utrecht to €4.18 in Palma. In general, observations in Palma recorded fewer bar staff per customer and more female and older bar staff (Table 2). Across all customer behaviour variables, mean ratings were lowest in Ljubljana although differences between cities were only significant for sexual competition and rowdiness. There were no significant differences between cities in mean ratings of customer intoxication (Liverpool and Utrecht 4.0, Palma 3.7, Ljubljana 3.5, *P* = 0.313).

At the initial stage of hierarchical modelling, significant associations were seen between customer intoxication ratings and all physical environment characteristics, as well as most venue entry characteristics (Table 3). For bar activities, only the presence of a dance floor was associated with higher intoxication ratings, while for alcohol and food service, non-alcoholic (soft) drink promotions and plastic glassware were associated with higher intoxication ratings, and table and food service with lower ratings. For venue staff, the presence of glass collectors, poorer staff monitoring, staff attitude, staff boundaries and higher levels of permissiveness were associated with intoxication. Younger clientele and higher levels of customer dancing, sexual activity/competition (combined scale) and rowdiness were associated with increased intoxication. Of the five contextual variables analysed, only greater number of customers and later observation time were associated with higher intoxication.

Non-significant variables (city, police outside the venue, outdoor drinking area) were excluded from further analyses.

**Table 1.** Proportion of observations displaying environmental characteristics, and mean scale ratings for environmental measures, by city of observation.

| | | Liverpool | Palma | Utrecht | Ljubljana | *P* |
|---|---|---|---|---|---|---|
| **Number of venues** | | 15 | 15 | 15 | 15 | |
| **Number of visits** [1] | | 60 | 60 | 57 | 60 | |
| **Venue entrance** | | | | | | |
| Door staff | % Yes | 98.3 | 88.3 | 75.4 | 63.3 | <0.001 |
| Queue | % Yes | 15.0 | 35.0 | 31.6 | 13.3 | 0.006 |
| Entrance fee | % Yes | 11.7 | 40.0 | 14.0 | 26.7 | 0.001 |
| House rules (entry) | % Yes | 8.3 | 46.7 | 31.6 | 41.7 | <0.001 |
| **Physical environment** | | | | | | |
| Seating | Mean | 6.8 | 6.5 | 7.5 | 4.0 | <0.001 |
| Noise | Mean | 6.2 | 6.5 | 5.8 | 5.1 | <0.001 |
| Crowding | Mean | 4.7 | 3.9 | 5.1 | 3.7 | 0.001 |
| Ventilation | Mean | 2.1 | 3.6 | 3.6 | 2.4 | <0.001 |
| Temperature | Mean | 4.2 | 4.7 | 5.4 | 4.4 | <0.001 |
| Clearing | Mean | 4.8 | 4.8 | 6.6 | 4.4 | <0.001 |
| Glass on floor | Mean | 2.5 | 1.6 | 2.5 | 1.4 | 0.006 |
| Cleanliness | Mean | 4.4 | 4.6 | 6.2 | 4.1 | <0.001 |
| Toilets | Mean | 3.8 | 4.1 | 4.0 | 3.8 | 0.764 |
| Lighting | Mean | 3.1 | 4.2 | 3.6 | 2.8 | <0.001 |
| **Bar activities** | | | | | | |
| Dance floor | % Yes | 86.7 | 46.7 | 71.9 | 36.7 | <0.001 |
| Pool tables | % Yes | 6.7 | 11.7 | 0.0 | 6.7 | 0.080 |
| TV screens | % Yes | 68.3 | 57.1 | 52.6 | 46.7 | 0.103 |
| House rules (inside) | % Yes | 3.3 | 38.3 | 12.3 | 63.3 | <0.001 |
| Rock/heavy music | % Yes | 3.3 | 31.7 | 5.3 | 23.3 | <0.001 |
| Rap/hiphop music | % Yes | 58.3 | 0.0 | 19.3 | 15.0 | <0.001 |
| Pop/dance music | % Yes | 90.0 | 68.3 | 78.9 | 58.3 | 0.001 |
| **Alcohol and food** | | | | | | |
| Alcoholic drink promotions | % Yes | 46.7 | 13.3 | 17.5 | 28.3 | <0.001 |
| Low drink prices [2] | % Yes | 37.9 | 73.3 | 66.7 | 36.7 | <0.001 |
| High alcohol drinks | % Yes | 41.7 | 95.0 | 5.3 | 40.0 | <0.001 |
| Soft drink promotions | % Yes | 1.7 | 21.7 | 21.1 | 15.0 | 0.007 |
| Plastic glassware | % Yes | 30.0 | 11.9 | 8.8 | 73.3 | <0.001 |
| Table service | % Yes | 3.3 | 25.0 | 7.0 | 78.3 | <0.001 |
| Food service | % Yes | 3.3 | 6.7 | 3.5 | 16.7 | 0.018 |

**Table 1.** *Cont.*

|  |  | Liverpool | Palma | Utrecht | Ljubljana | *P* |
|---|---|---|---|---|---|---|
| *Price of a bottle of lager (euros)* [3] | Mean | 3.81 | 4.18 | 2.28 | 2.89 | <0.001 |
| *Price of a glass of wine (euros)* | Mean | 3.56 | 3.69 | 2.81 | 2.29 | <0.001 |
| *Price of a vodka and orange (euros)* | Mean | 3.73 | 7.13 | 5.39 | 4.29 | <0.001 |
| *Price of a glass of coke (euros)* | Mean | 1.69 | 3.65 | 2.10 | 2.02 | <0.001 |

[1] Four visits were made to each venue with the exception of two venues in Utrecht, where only three visits were possible. One visit in Utrecht was excluded as no measurement of intoxication was recorded.

[2] Based on the mean price of either lager or spirits depending on which drink was most commonly being consumed in the venue.

[3] Prices in Liverpool were converted from £ sterling to Euros at an exchange rate of 1.1531.

**Table 2.** Percentage of visits recording staffing and customer factors, and mean ratings for staffing and customer related scales, by city.

|  |  | Liverpool | Palma | Utrecht | Ljubljana | *P* |
|---|---|---|---|---|---|---|
| **Staff characteristics** |  |  |  |  |  |  |
| Fewer bar staff | % Yes | 16.7 | 70.0 | 38.6 | 10.0 | <0.001 |
| Young staff | % Yes | 55.0 | 0.0 | 47.4 | 46.7 | <0.001 |
| Male staff | % Yes | 48.3 | 26.7 | 73.7 | 60.0 | <0.001 |
| Glass collectors | % Yes | 78.3 | 61.7 | 68.4 | 8.3 | <0.001 |
| **Staff behaviours** |  |  |  |  |  |  |
| Staff monitoring | Mean | 2.6 | 3.3 | 3.8 | 2.9 | 0.004 |
| Staff coordination | Mean | 4.2 | 5.0 | 4.7 | 3.8 | 0.002 |
| Staff attitude | Mean | 1.5 | 3.2 | 2.1 | 1.7 | <0.001 |
| Staff boundaries | Mean | 1.3 | 3.4 | 3.4 | 1.6 | <0.001 |
| Permissiveness | Mean | 2.9 | 1.8 | 2.4 | 0.9 | <0.001 |
| **Customer type** |  |  |  |  |  |  |
| Male clientele | % Yes | 60.0 | 75.0 | 63.2 | 81.7 | 0.033 |
| Young clientele | % Yes | 11.7 | 8.3 | 33.3 | 11.7 | 0.001 |
| Single sex groups | % Yes | 70.0 | 36.7 | 77.2 | 30.0 | <0.001 |
| **Customer behaviours** |  |  |  |  |  |  |
| Dancing | Mean | 4.5 | 3.7 | 4.8 | 3.3 | 0.033 |
| Sexual activity | Mean | 3.2 | 3.1 | 3.0 | 2.6 | 0.436 |
| Sexual competition | Mean | 3.5 | 2.7 | 2.7 | 1.7 | <0.001 |
| Rowdiness | Mean | 3.3 | 2.9 | 3.2 | 0.9 | <0.001 |
| Movement | Mean | 4.8 | 4.7 | 4.9 | 4.0 | 0.099 |
| **Additional variables** |  |  |  |  |  |  |
| Police outside | % Yes | 33.3 | 18.3 | 7.3 | 1.7 | <0.001 |
| Outdoor area | % Yes | 23.3 | 66.7 | 63.2 | 86.7 | <0.001 |
| 100+ customers | % Yes | 63.3 | 81.7 | 59.6 | 35.0 | <0.001 |
| **Intoxication *** | Mean | 4.0 | 3.7 | 4.0 | 3.5 | 0.313 |

* Main variable of interest.

A multivariate analysis was conducted for each block of variables, with models also including customer number and observation time variables. Here, no venue entry characteristics were associated with intoxication ratings (Table 3). Within physical environment variables, greater movement/crowding (combined scale) and poorer washroom facilities were associated with higher ratings. The presence of a

dance floor and TV screens were the only bar activity factors associated with intoxication. For alcohol and food service, promotion of non-alcoholic drinks and plastic glassware were associated with higher ratings and table service with lower ratings. Poorer staff monitoring and greater permissiveness were the only staff factors associated with higher intoxication. Customer factors associated with higher ratings were younger clientele, dancing, sexual activity/competition and rowdiness.

**Table 3.** Hierarchical modelling: Associations between environmental characteristics and customer intoxication ratings.

| | | | | | | Multivariate | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Bivariate** | | **Block analysis** | | **Model 1** | | **Model 2** | |
| | **Variable** | *Estimate* | *P* | *Estimate* | *P* | *Estimate* | *P* | *Estimate* | *P* |
| **Contextual** | >100 customers | 0.945 | *** | | | 0.037 | ns | 0.139 | ns |
| **variables #** | Later visit | 1.223 | *** | | | 0.483 | * | 0.740 | *** |
| **Venue** | Door staff | 1. 017 | ** | 0.496 | ns | | | | |
| **entrance** | Queue | 0.715 | * | −0.229 | ns | | | | |
| | Entrance fee | 0.823 | * | 0.124 | ns | | | | |
| | House rules (entry) | 0.201 | ns | 0.142 | ns | | | | |
| **Physical** | Seating | 0.240 | *** | 0.062 | ns | | | | |
| **environment** | Noise level | 0.282 | *** | 0.060 | ns | | | | |
| | Movement/Crowding | 0.191 | *** | 0.087 | * | 0.025 | ns | 0.056 | ns |
| | Ventilation/Lighting | 0.280 | *** | 0.092 | ns | | | | |
| | Temperature | 0.380 | *** | 0.058 | ns | | | | |
| | Clearing/Cleanliness | 0.139 | *** | 0.017 | ns | | | | |
| | Glass on floor | 0.296 | *** | 0.030 | ns | | | | |
| | Toilets | 0.316 | *** | 0.128 | * | 0.097 | * | 0.103 | * |
| **Bar activities** | Dancefloor | 1.252 | *** | 0.993 | *** | 0.269 | ns | 0.557 | * |
| | Pool tables | −0.046 | ns | −0.181 | ns | | | | |
| | TV screens | 0.282 | ns | 0.569 | * | 0.107 | ns | 0.266 | ns |
| | House rules (inside) | −0.132 | ns | −0.093 | ns | | | | |
| | Rock/heavy music | −0.312 | ns | −0.026 | ns | | | | |
| | Rap/hiphop music | 0.080 | ns | −0.217 | ns | | | | |
| | Pop/dance music | 0.115 | ns | −0.286 | ns | | | | |
| **Alcohol and** | Alcoholic drink promotions | 0.297 | ns | 0.336 | ns | | | | |
| **food service** | Low drink prices | −0.350 | ns | −0.344 | ns | | | | |
| | Soft drink promotions | 0.888 | ** | 0.833 | ** | 0.631 | * | 0.690 | ** |
| | Plastic glassware | 0.706 | ** | 0.818 | ** | 0.602 | ** | 0.614 | ** |
| | Table service | −0.936 | ** | −0.882 | ** | 0.031 | ns | −0.090 | ns |
| | Food service | −1.183 | * | −0.394 | ns | | | | |
| **Venue staff** | Fewer bar staff | 0.345 | ns | −0.027 | ns | | | | |
| | Young staff | −0.084 | ns | 0.020 | ns | | | | |
| | Male staff | 0.406 | ns | 0.202 | ns | | | | |
| | Glass collectors | 0.539 | * | 0.235 | ns | | | | |
| | Staff monitoring | 0.209 | *** | 0.163 | ** | 0.071 | ns | 0.081 | ns |
| | Staff coordination | 0.024 | ns | −0.113 | ns | | | | |
| | Staff attitude | 0.206 | * | 0.181 | ns | | | | |
| | Staff boundaries | 0.130 | * | 0.052 | ns | | | | |
| | Permissiveness | 0.526 | *** | 0.425 | *** | 0.160 | * | 0.298 | *** |

**Table 3.** *Cont.*

| | | Bivariate | | Block analysis | | Multivariate | | | |
| | | | | | | Model 1 | | Model 2 | |
| | Variable | *Estimate* | *P* | *Estimate* | *P* | *Estimate* | *P* | *Estimate* | *P* |
|---|---|---|---|---|---|---|---|---|---|
| **Customer factors** | Male clientele | −0.017 | ns | −0.018 | ns | | | | |
| | Young clientele | 0.886 | ** | 0.590 | * | 0.316 | ns | | |
| | Single sex groups | 0.089 | ns | −0.081 | ns | | | | |
| | High alcohol drinks | 0.181 | ns | 0.047 | ns | | | | |
| | Dancing | 0.276 | *** | 0.126 | ** | 0.073 | ns | | |
| | Sexual activity/competition | 0.237 | *** | 0.085 | * | 0.065 | * | | |
| | Rowdiness | 0.460 | *** | 0.243 | *** | 0.125 | ns | | |

Analysis uses hierarchical modelling. # These two variables were included in all block analyses. ns = not significant; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$. For significant associations in multivariate analyses, slope direction indicates whether the variable was associated with an increase or decrease (-) in intoxication rating.

All variables independently associated with intoxication ratings in block analyses were entered into an overall model (Model 1, Table 3), along with number of customers and observation timing. The model identified six factors independently associated with higher intoxication ratings: later observation time, poorer washroom facilities, non-alcoholic drink promotions, plastic glassware, greater permissiveness and higher customer sexual activity/competition. As customers will be attracted to venues based on their social and physical environments, a second model was constructed that excluded customer-focused variables. Here, all independent associations between non-customer factors and intoxication remained, and those with later observation timing, non-alcoholic drink promotions and permissiveness were strengthened. An independent relationship also emerged between intoxication ratings and the presence of a dance floor.

## 4. Discussion

This study is among the first to explore associations between intoxication and environmental factors in European bars, and the first to do so cross-nationally. The study's multi-country nature means findings may have been affected by structural and cultural factors, such as differences in licensing legislation and variation in the interpretation of bar characteristics and intoxication across research teams. To address this latter point, we used an established methodology [17,19] and a detailed training programme to develop consistency in measurement recording. Nevertheless, the relatively small variations seen between cities in ratings of intoxication may in part be due to variations in researchers' cultural exposure and norms for what was considered drunk. Drink prices cannot be considered representative for each city, while drink serving sizes and strengths may have varied [21]. Further, as with all cross-sectional studies, we cannot ascertain causal relationships between bar characteristics and intoxication. However, our study does identify characteristics of bars where intoxication may be more likely, and consequently provides intelligence to inform bar-focused interventions to prevent alcohol-related harm.

Several of our findings are consistent with research elsewhere. Many characteristics typically associated with alcohol-related harm (e.g., loud music, crowding, lack of seating) [20] were associated

with intoxication in bivariate analysis, and some that were significant in multivariate analysis have been identified as risk factors elsewhere. For example, permissive bar environments, poor cleanliness (e.g., poorer washroom facilities) and measures of sexual competition have been associated with aggression and disorder in studies in Canada [17], Australia [22] and Scotland [12].

Other aspects of our findings are novel. Thus, this is the first observational study to identify associations between intoxication and both plastic glassware and promotion of non-alcohol drinks. Plastic glassware is widely used as a harm reduction measure in drinking premises, with the aim of preventing serious injuries following the use of glassware as a weapon [23,24]. In some countries its use can be mandated through licensing legislation. In Glasgow, Scotland, glass was banned in late night drinking venues in 2006. There were some exceptions, and a study found that disorder in bars that used only plastic glassware resulted in fewer injuries than that occurring in bars where glass was still used [24]. Plastic glassware can therefore help reduce injury in bars, yet does little to prevent violence nor, as our study indicates, the intoxication that drives this. Thus, use of plastic glassware should not be considered sufficient to demonstrate responsible management; its use must be accompanied by action to reduce intoxication in order to prevent broader alcohol-related harms, including those that can occur when intoxicated individuals leave the relative safety of glass-free premises [25].

A more surprising finding was the association between non-alcoholic drink promotions and higher intoxication ratings. There are several possibilities for this. Firstly, as with plastic glassware, the promotion of non-alcoholic drinks may reflect a concerted effort in problematic premises to reduce harm. Another explanation may relate to modern drinking patterns. A survey conducted alongside this study found high levels of preloading among nightlife users in the four cities [7]. With many customers entering bars after having already consumed significant quantities of alcohol, venue managers may consider non-alcoholic drinks to provide greater potential for sales; particularly legal sales since service of alcohol to intoxicated individuals is often illegal. Preloading may also account for the lack of association between intoxication and cheap alcoholic drink promotions, lower alcohol prices or high alcohol content drinks. However, the most plausible explanation might be provided by the fact that many non-alcoholic drinks promoted were "energy" drinks (e.g., containing caffeine). These drinks are commonly used as mixers with spirits, can desensitise users to the symptoms of intoxication, can have diuretic effects that can increase thirst, and are used as stimulants by nightlife users to help them stay awake and continue drinking over long nights [26,27]. Bars may exploit these effects and promote energy drinks to encourage customers to continue purchasing and consuming drinks. Numerous studies have identified increased risks of intoxication and alcohol-related problems among individuals that consume alcohol mixed with energy drinks [28–30]. Any efforts to promote non-alcoholic drinks in bars as a preventive measure should be implemented with caution, and should specifically exclude energy drinks.

In line with customer behaviour reflecting bar policy, after customer-focused variables were removed from analyses the relationship between permissive environments and intoxication was strengthened. Bars that tolerate intoxication and raucous behaviour are likely to attract individuals who want to get drunk and behave in ways that may prevented elsewhere. Among other management-focused variables only poor washroom facilities, a potential marker of staff negligence, was associated with intoxication in our final models. However, all physical environment characteristics showed strong

associations with intoxication before interactions between them were controlled for. This indicates that factors such as inadequate glass clearing, poor cleanliness, and poor ventilation and lighting cluster in high risk bars, suggesting a general lack of managerial care in such premises. Thus, while poor physical environments may not cause intoxication per se, they could be considered as a syndrome diagnostic of venues where intoxication and harm is likely. The development of standards for licensed premises is recommended through international alcohol strategies [1,2]. However, evidence for the effectiveness of such measures as standalone interventions is scant [31]. Where management-focused interventions have shown success they have typically been backed up by strong enforcement and packaged within multi-agency programmes [15,31–33]. The importance of enforcing and monitoring licensing legislation is also recognised in international strategies. Ensuring such activity is implemented alongside measures to train staff and develop standards should be considered imperative.

Professionally-managed bars have the potential to reduce drunkenness and so contribute to both safer drinking environments and public health. Venue staff can control access to alcohol, manage confrontation, provide environments where abusive behaviour is not tolerated, and offer customer care services. Whilst we have identified the potential impacts of poor bar management, other drinking environments (e.g., private parties, public spaces) offer little opportunity for managing drinkers' behaviour and safety. Recent years have seen a trend in Europe towards reduced alcohol sales in on-trade premises and increased sales in supermarkets and shops for consumption in private settings, driven largely by cheaper off-sales prices [34]. In the longer term, providing well-managed environments where people can socialise safely may be a more sustainable strategy for professional bar operators than focusing purely on selling large quantities of alcohol. Whilst strategies should aim to create well-managed bars that do not permit drunkenness, such practices are likely to be helped by regulation that prevents the sale of cheap alcohol elsewhere.

## 5. Conclusions

Preventing harm in drinking environments requires interventions that recognise and address the contributors to intoxication. Consistent with international research, our study suggests that venues where intoxication occurs can have a clustering of "bad" environmental features that manifest through poor managerial care. The variables with the strongest relationships with intoxication ratings were permissiveness (identified as a general indifference towards patrons' behaviours) and later observation time. Thus, permissive late night venues are likely to attract individuals who want to get (or are already) drunk and provide environments with few behavioural expectations. In such venues, harm reduction measures such as plastic glassware can be common, implemented specifically to prevent intoxicated aggression turning into serious injury. These measures may be tokenistic; having little impacts on sales and profits and being relatively easy for venues to adopt, whether to demonstrate social responsibility or meet licensing requirements. However, they do little to address the root causes of harm. Our findings suggest that greater focus on managerial practice is needed. All features of the physical, social and staffing environment within bars stem from management decisions, including how venues are designed, how staff are trained, and how customers are permitted to behave. In some circumstances, attracting heavy drinking patrons may represent a commercially attractive model despite the poor health and anti-social outcomes associated with drunkenness. While many

establishments may be well placed to adopt recognised managerial standards some of the most risky will only change when faced with regulation and enforcement.

## Acknowledgements

## Conflicts of Interest

In the past three years, the Centre for Public Health has received a grant from Drinkaware to undertake an independent study of drinking behaviours among students and MAB has provided them with independent medical advice. Drinkaware is an independent UK-wide charity supported by voluntary contributions from the alcohol and supermarket industries and governed through a memorandum of understanding between the Department of Health, Home Office, Scottish Executive, Welsh Assembly Government, Northern Ireland Office and Portman Group.

## References

1. World Health Organization. *Global Strategy to Reduce the Harmful Use of Alcohol*. World Health Organization: Geneva, 2010. Available online: http://www.who.int/substance_abuse/activities/gsrhua/en/ (accessed on 9 November 2012).
2. World Health Organization Regional Office for Europe. *European Action Plan to Reduce the Harmful Use of Alcohol 2012–2020*. World Health Organization Regional Office for Europe: Copenhagen, 2011. Available online: http://www.euro.who.int/en/who-we-are/governance/regional-committee-for-europe/past-sessions/sixty-first-session/documentation/working-documents/wd13-european-action-plan-to-reduce-the-harmful-use-of-alcohol-20122020 (accessed on 9 November 2012).
3. Gmel, G.; Heeb, J.L.; Rezny, L.; Rehm, J.; Kuo-Mohler, M. Drinking patterns and traffic casualties in Switzerland: Matching survey data and police records to design preventive action. *Public Health* **2005**, *5*, 426–436.
4. Rowe, S.C.; Wiggers, J.H.; Wolfenden, L.; Francis, J.L. Establishments licensed to serve alcohol and their contribution to police-recorded crime in Australia: Further opportunities for harm reduction. *J. Stud. Alcohol Drugs* **2010**, *71*, 909–916.

5. Bellis, M.A.; Hughes, K.; Quigg, Z.; Morleo, M.; Jarman, I.; Lisboa, P. Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation. *Subst. Abuse Treat. Prev. Policy* **2010**, *5*, doi:10.1186/1747-597X-5-5.

6. Clapp, J.D.; Reed, M.B.; Win, J.W.; Shillington, A.M.; Croff, J.; Holmes, M.R.; Trim, R.S. Blood alcohol concentrations among bar patrons: A multi-level study of drinking behaviour. *Drug Alcohol Depend.* **2009**, *102*, 41–48.

7. Hughes, K.; Quigg, Z.; Bellis, M.A.; van Hasselt, N.; Calafat, A.; Kosir, M.; Juan, M.; Duch, M.; Voorham, L. Drinking behaviours and blood alcohol concentration in four European drinking environments: A cross-sectional study. *BMC Public Health* **2011**, *11*, doi:10.1186/1471-2458-11-918.

8. Livingston, M.; Chikritzhs, T.; Room, R. Changing the density of alcohol outlets to reduce alcohol-related problems. *Drug Alcohol Rev.* **2007**, *26*, 557–566.

9. Grubesic, T.H.; Pridemore, W.A. Alcohol outlets and clusters of violence. *Int. J. Health Geogr.* **2011**, *10*, doi:10.1186/1476-072X-10-30.

10. Livingston, M. Alcohol outlet density and harm: Comparing the impacts on violence and chronic harms. *Drug Alcohol Rev.* **2011**, *30*, 515–523.

11. Homel, R.; Carvolth, R.; Hauritz, M.; McIlwain, G.; Teague, R. Making licensed premises safer for patrons: What environmental factors should be the focus of interventions? *Drug Alcohol Rev.* **2004**, *23*, 19–29.

12. Forsyth, A.J.M. Assessing the Relationships between Late Night Drinks Marketing and Alcohol-Related Disorder in Public Space. Available online: http://alcoholresearchuk.org/2007/04/06/relationships-between-late-night-drinks-marketing-and-alcohol-related-disorder/ (accessed on 9 November 2012).

13. Graham, K.; Osgood, D.W.; Wells, S.; Stockwell, T. To what extent is intoxication associated with aggression in bars? A multilevel analysis. *J. Stud. Alcohol* **2006**, *67*, 382–390.

14. Newton, A.D.; Hirschfield, A. Measuring violence in and around licensed premises: The need for a better evidence base. *Crime Prevent. Commun. Saf.* **2009**, *11*, 153–170.

15. Graham, K.; Homel, R. *Raising the Bar: Preventing Aggression in and Around Bars, Pubs and Clubs*. Willan Publishing: Cullompton, Devon, UK, 2008; pp. 58–168.

16. Madensen, T.D.; Eck, J.E. Violence in bars: Exploring the impact of place manager decision-making. *Crime Prevent. Commun. Saf.* **2008**, *10*, 111–125.

17. Graham, K.; Bernard, S.; Osgood, D.W.; Wells, S. Bad nights or bad bars? Multi-level analysis of environmental predictors of aggression in late-night large-capacity bars and clubs. *Addiction* **2006**, *101*, 1569–1580.

18. Green, J.; Plant, M.A. Bad bars: A review of risk factors. *J. Subst. Abuse* **2007**, *12*, 157–189.

19. Graham, K.; La Rocque, L.; Yetman, R.; Ross, T.J.; Guistra E. Aggression and barroom environments. *J. Stud. Alcohol* **1980**, *41*, 277–292.

20. Hughes, K.; Quigg, Z.; Eckley, L.; Bellis, M.A.; Jones, L.; Calafat, A.; Kosir, M.; van Hasselt, N. Environmental factors in drinking venues and alcohol-related harm: The evidence base for European intervention. *Addiction* **2011**, *106*, 37–46.

21. Gual, A.; Martos, A.R.; Lligona, A.; Llopis, J.J. Does the concept of a standard drink apply to viticultural societies? *Alcohol Alcohol.* **1999**, *34*, 153–160.

22. Homel, R.; Clark, J. *The Prediction and Prevention of Violence in Pubs and Clubs. Crime Prevention Studies*; Criminal Justice Press: New York, NY, USA, 1994.

23. Anderson, Z.; Whelan, G.; Hughes, K.; Bellis, M.A. Evaluation of the Lancashire Polycarbonate Glass Pilot Project. Available online: http://www.cph.org.uk/showPublication.aspx?pubid=561 (accessed on 9 November 2012).

24. Forsyth, A.J.M. Banning glassware from nightclubs in Glasgow (Scotland): Observed impacts, compliance and patron's views. *Alcohol Alcohol.* **2008**, *43*, 111–117.

25. Bellis, M.A.; Hughes, K. Getting drunk safely? Night-life policy in the UK and its public health consequences. *Drug Alcohol Rev.* **2011**, *30*, 536–545.

26. Ferreira, S.E.; De Mello, M.T.; Pompeia, S.; De Souza-Formigoni, M.L.O. Effects of energy drink ingestion on alcohol intoxication. *Alcohol Clin. Exp. Res.* **2006**, *30*, 598–605.

27. Marczinski, C.A. Alcohol mixed with energy drinks: Consumption patterns and motivations for use in U.S. college students. *Int. J. Environ. Res. Public Health* **2011**, *8*, 3232–3245.

28. Thombs, D.L.; O'Mara, R.J.; Tsukamoto, M.; Rossheim, M.E.; Weiler, R.M.; Merves ML; Goldberger, B.A. Event-level analyses of energy drink consumption and alcohol intoxication in bar patrons. *Addict. Behav.* **2010**, *35*, 325–330.

29. O'Brien, M.C.; McCoy, T.P.; Rhodes, S.D.; Wagoner, A.; Wolfson, M. Caffeinated cocktails: Energy drink consumption, high-risk drinking, and alcohol-related consequences among college students. *Acad. Emerg. Med.* **2008**, *15*, 453–460.

30. Brache, K.; Stockwell, T. Drinking patterns and risk behaviors associated with combined alcohol and energy drink consumption in college drinkers. *Addict. Behav.* **2011**, *36*, 1133–1140.

31. Jones, L.; Hughes, K.; Atkinson, A.M.; Bellis, M.A. Reducing harm in drinking environments: A systematic review of effective approaches. *Health Place* **2011**, *17*, 508–518.

32. Wallin, E.; Norstrom, T.; Andreasson, S. Alcohol prevention targeting licensed premises: A study of effects on violence. *J. Stud. Alcohol* **2003**, *64*, 270–277.

33. Warpenius, K.; Holmila, M.; Mustonen, H. Effects of a community intervention to reduce the serving of alcohol to intoxicated patrons. *Addiction* **2010**, *105*, 1032–1040.

34. Hughes, K.; Bellis, M.A. Drinking Environments. In *Alcohol in the European Union: Consumption, Harm and Policy Approaches*; Anderson P, Moller L, Galea G, Eds.; World Health Organization Regional Office for Europe: Copenhagen, Denmark, 2012; pp. 63–68.

**Table A1.** Description of observational schedule measurements used in analyses.

| Scale variables | | | Categorical variables | |
|---|---|---|---|---|
| **Label** | **Scale** | **Scale range** | **Label** | **Yes/No** |
| Intoxication * | Intoxication level of people in the venue | 0 no sign of intoxication 9 → everyone is drunk | Door staff | Staff managing entrance to the venue |
| Seating | Proportion of the venue floor space containing seating | 0 90% or more → 9 <10% | Queue | There was a queue to enter the venue |
| | | | Entrance fee | Entrance fee had to be paid |
| Noise | Noise level in loudest part of venue | 0 very quiet/easy to talk → 9 hurts ears/cannot talk | House rules (entry) | House rules displayed at venue entrance |
| Crowding [a] | Crowding at busiest time (exc.dancefloor) | 0 lots of space → 9 cannot move | Dance floor | Venue had a designated dance floor area |
| Movement [a] | Movement (at busiest time/part of venue) | 0 little movement → 9 constant | Pool tables | Venue had pool tables |
| Ventilation [b] | Ventilation in the venue | 0 extremely fresh → 9 extremely stuffy/stale | TV screens | Television screens [g] visible in the venue |
| Lighting [b] | Level of lighting inside the venue | 0 bright/can clearly see → 9 very dark/can hardly see | House rules (venue) | House rules displayed inside the venue |
| Temperature | Temperature in the venue | 0 very cold → 9 very warm | Rock/heavy music | Rock/heavy metal music being played |
| Clearing [c] | Clearing of tables/other surfaces [e] | 0 always → 9 never | Rap/hip hop music | Rap or hip hop music being played |
| Cleanliness [c] | Extent that indoor premises are kept clean (spills, litter) including the floor | 0 always → 9 never | Pop/dance music | Pop or dance music being played |
| | | | Alcoholic drink promotions | Cheap drink promotions [h] offered |
| Glass on floor | Extent of glass/bottles on venue floor[f] | 0 none → 9 everywhere | Low drinks prices | Drink prices below average for that city [1] |
| Toilets | Extent that toilets are kept in order (e.g., locks) and stocked (soap, toilet rolls *etc.*) | 0 clean/fresh/stocked → 9 vandalised/foul | Soft drink promotions | Non-alcoholic drinks promoted [J] |
| | | | Plastic glassware | Drinks served in plastic glasses [k] |
| Staff monitoring | To what extent are staff generally monitoring all areas of the venue? | 0 constantly monitored → 9 unmonitored | Table service | Drinks served at tables |
| | | | Food service | Food available during the observation |
| Staff coordination | To what extent do staff seem to be coordinated as a team? | 0 constant radio or eye contact → 9 not coordinated at all | Fewer bar staff | 30 or more customers per bar server |
| | | | Young staff | >50% thought to be under age 25 |
| Staff attitude | Are servers cheerful, courteous and friendly (CCF) in a professional way or distant, unfriendly, stern or even rude/obnoxious (DUS)? | 0 all were CCF → 9 all were DUS | Male staff | >50% male |
| | | | Glass collectors | Glass collectors working in the venue |
| | | | Male clientele | >50% clientele were male |
| Staff boundaries | Extent that servers maintained professional (P) boundaries from patrons | 0 all completely P, clear boundaries → all socialising with customers | Young clientele | >50% clientele estimated to be <age 22 |
| | | | Single sex groups | >50% clientele in single sex groups |

**Table A1.** *Cont.*

| Scale variables | | | Categorical variables | |
|---|---|---|---|---|
| **Label** | **Scale** | **Scale range** | **Scale** | **Label** |
| Permissiveness | Overall decorum /behavioural expectations | 0 no offensive/abusive behaviour → 9 anything goes | High alcohol drinks | High alcohol content [l] drinks most common |
| | | | Police outside | Police were outside the venue at entry |
| Dancing | Proportion of customers dancing | 0 <10% → 9 90% or more | Outdoor area | Outdoor eating/drinking/smoking area |
| Sexual activity [d] | Sexual activity in venue | 0 none → 9 explicit sexual contact | 100+ customers | 100+ customers in venue at peak time |
| Sexual competition [d] | Sexual competition in venue | 0 scoping not the focus for anyone → 9 scoping the focus of 76–100% | Later visit | Later 50% of observations (per city) |
| Rowdiness | Global rating of rowdiness in the venue | 0 none/very rare → 9 out of control | | |

* Main variable of interest. The following variables were strongly correlated and were combined into single scales measured from 0 to 18: [a] Crowding and movement (r = 0.686; cronbach's alpha 0.813); [b] Ventilation and Lighting (r = 0.607; cronbach's alpha 0.755); [c] Clearing and Cleanliness (r = 0.788; cronbach's alpha 0.881); [d] Sexual activity and Sexual competition (r = 0.765; cronbach's alpha 0.866); [e] Highest rating from two scales covering tables/other surfaces separately; [f] Highest rating from two scales covering glass/bottles separately; [g] Typically showing music videos or venue marketing/promotions; [h] e.g., buy one get one free, free shots; [i] Based on spirits or lager depending on which drink was most commonly being consumed in the venue; [j] Including energy drinks; [k] Partly or wholly; [l] High alcohol: spirits/wine, low alcohol: lager/cider/alcopops.

**RESEARCH ARTICLE**

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# Drinking behaviours and blood alcohol concentration in four European drinking environments: a cross-sectional study

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## Abstract

**Background:** Reducing harm in drinking environments is a growing priority for European alcohol policy yet few studies have explored nightlife drinking behaviours. This study examines alcohol consumption and blood alcohol concentration (BAC) in drinking environments in four European cities.

**Methods:** A short questionnaire was implemented among 838 drinkers aged 16-35 in drinking environments in four European cities, in the Netherlands, Slovenia, Spain and the UK. Questions included self-reported alcohol use before interview and expected consumption over the remainder of the night. Breathalyser tests were used to measured breath alcohol concentration (converted to BAC) at interview.

**Results:** Most participants in the Dutch (56.2%), Spanish (59.6%) and British (61.4%) samples had preloaded (cf Slovenia 34.8%). In those drinking < 3 h at interview, there were no differences in BAC by gender or nationality. In UK participants, BAC increased significantly in those who had been drinking longer, reaching 0.13% (median) in females and 0.17% in males drinking > 5 h. In other nationalities, BAC increases were less pronounced or absent. High BAC (> 0.08%) was associated with being male, aged > 19, British and having consumed spirits. In all cities most participants intended to drink enough alcohol to constitute binge drinking.

**Conclusions:** Different models of drinking behaviour are seen in different nightlife settings. Here, the UK sample was typified by continued increases in inebriation compared with steady, more moderate intoxication elsewhere. With the former being associated with higher health risks, European alcohol policy must work to deter this form of nightlife.

## Background

Reducing the negative consequences of drinking and alcohol intoxication is a key global health priority [1]. The European Region has the highest levels of alcohol consumption in the world and the greatest proportion of ill health and premature death attributable to alcohol [2]. Although most alcohol-related deaths occur in older age groups, the burden of alcohol on mortality and morbidity falls disproportionately on young people, largely through acute alcohol-related injuries [3-5]. The relationship between alcohol and injury is dose-responsive, with injury risks increasing with blood alcohol concentration

(BAC) [6] and being particularly acute for heavy episodic drinkers [7]. Studies show that heavy episodic drinking peaks in the late teenage years and early adulthood [8], with much alcohol use and harm in this age group taking place in public drinking environments [9]. Thus, policy recommendations to reduce harm from alcohol both internationally and in Europe are focusing on managing drinking environments, including through regulation, enforcement, management policies for bars and nightclubs, bar staff training and care for intoxicated individuals [1]. However, there are currently little empirical data available on drinking behaviours in European drinking environments to inform such measures.

There are wide variations in drinking cultures across Europe. Traditionally, a north-south gradient has been characterised by daily, moderate consumption of wine

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with food in Southern countries and infrequent heavy consumption of beer or spirits as an intoxicant in Northern countries [10]. Whilst cultural differences are still apparent [10-12], drinking patterns are thought to be converging across Europe. In particular, recent years have seen increases in heavy episodic drinking among young people in many European countries [13], with concerns that Northern cultures of heavy drinking and intoxication are spreading [4,14]. However, cross-national comparisons of alcohol use in young Europeans typically rely on school surveys of adolescents [13,15]. Data on drinking behaviours in young adults are drawn largely from general population surveys, that are known to underestimate consumption [16,17] and provide little context on nightlife drinking behaviours. A small number of cross-national studies have examined nightlife drinking behaviours and associated harms in young Europeans [11,12] with, for example, higher levels of drunkenness having been identified in those from Northern European countries [11]. However, few European studies have attempted to measure drinking behaviours actually in nightlife environments, and none have done so on a cross-national basis.

Recent single-country studies have used breathalyser tests alongside surveys to measure alcohol consumption and intoxication in nightlife settings [18-21]. In the UK, strong correlations have been found between reported alcohol use, BAC and intoxication in nightlife, with associations found between certain nightlife behaviours (e.g. preloading [consuming off-licensed alcohol before entering the nightlife environment]; staying out later) and higher levels of alcohol consumption and intoxication [18]. Here, we present findings from a study that used a similar methodology in nightlife environments in four European cities: Liverpool (UK); Ljubljana (Slovenia); Palma de Mallorca (Spain); and Utrecht (the Netherlands). While each city cannot be considered nationally representative, all are popular nightlife locations selected to be indicative of a range of nightlife cultures. Thus, UK nightlife is typically characterised by high levels of alcohol use, drunkenness and related harms including violence [22-24], while reports suggest that alcohol use and associated violence have also been increasing in Dutch nightlife settings [25]. The Balearic Islands in Spain have a long history of nightlife linked to international tourism; while heavy nightlife drinking has traditionally been limited to tourists, recent years have seen increasing alcohol use in local youth, linked to the practice of botellón–the gathering of young people in public places to consume off licensed alcohol (often before visiting bars and nightclubs) [26]. Research on nightlife in Slovenia is scarce; while levels of adolescent alcohol use are relatively high [27] little is known about nightlife drinking behaviours, although associated problems such as violence are considered rare [28].

The objectives of this study were to examine the amount of alcohol young adults reported drinking across the course of a night out in the four cities, and to measure BAC among drinkers during their night out. The study aimed to establish and test a cross-national methodology to measure drinking behaviours in nightlife environments, and to provide an initial assessment of variation in drinking patterns and intoxication across different European nightlife settings. Developing this knowledge is important in understanding differences in nightlife alcohol consumption across cultures and consequently in informing the development of appropriate and culturally relevant measures to reduce harm in drinking environments. Thus, analyses explore differences between city samples in reported drinking behaviours and BAC levels over a night out.

## Methods
The study took place in four cities: Utrecht (the Netherlands); Ljubljana (Slovenia); Palma de Mallorca (Spain); and Liverpool (UK). All sites were part of a broader investigation into alcohol-related harm in drinking environments [22]. At the time of this study[1], Utrecht (population ~300,000) city centre had around 160 nightlife venues (pubs, bars and nightclubs), with most closing between 2 am and 5 am. Liverpool (population ~435,000) city centre had 304 nightlife venues, over half of which were licensed to stay open later than 2 am. Despite being the only capital city studied, Ljubljana (population ~277,000) had the smallest number of city centre nightlife venues (n = 41) that closed between midnight and 5 am. Palma (population ~400,000) reported 500 nightlife venues within its broader municipality area, including those in tourist resorts surrounding the city; however our study focused on city centre drinking environments popular with locals, where closing times were largely between 4 am and 6 am. In Liverpool, Ljubljana and Palma, the legal age for alcohol sales was 18. In Utrecht, beer and wine sales were permitted at age 16, with stronger alcohol sales (i.e. spirits) restricted to those aged 18 and over.

A short questionnaire was developed to examine: the time at which individuals had started drinking on the survey night; alcohol consumption up to the point of interview; whether they had preloaded (defined as drinking alcohol at their own or a friend's home before going out; participation in botellón was also recorded in Spain); expected alcohol consumption over the remainder of the night; whether they had, or intended to, use illicit drugs that night; and expected home time. The questionnaire was based on an existing tool used in UK drinking environments [18], adapted at a research meeting to be applicable in each location and ensure all questions were translated appropriately. A training package was delivered to research leads from each country to instruct them on

consistent implementation of the study. Each research lead then recruited field researchers from their own city and repeated the training session with them.

In each city, researchers were instructed to identify peak periods for nightlife activity and to undertake data collection at these times in the streets around drinking venues popular with young people. The study took place on Thursday, Friday and Saturday nights (September to November 2010) between 10 pm and 5 am, with study timings dependent upon local nightlife activity. Recruitment of participants used a structured approach with teams of two researchers working in parallel and using a series of different locations in each city for periods of 1 h at a time. A target sample of 200 participants was set for each city (based on previous work in the UK [18]); the eligibility criteria was being a 16-35 year old drinker, using bars and nightclubs in the relevant city on the night of survey, and being a national of the survey country. To meet ethics requirements, researchers were instructed to visually assess potential participants and exclude those who were already too intoxicated to participate; the number of such individuals excluded ranged from three in Slovenia to 21 in Spain.

Researchers approached potential participants and asked them if they had time to complete a short anonymous survey about alcohol. Of 1,495 individuals approached, 483 refused to participate before the nature of the survey was explained to them and a further 131 declined after receiving a study explanation. Thus, overall compliance was 58.9% (Netherlands 66.8%, Slovenia 48.6%, Spain 55.4%, UK 69.3%). For the 881 individuals consenting, questionnaires were completed by researchers through an interview process. Following questionnaire completion, participants were breathalysed using the Lion 500 alcometer and results were recorded on their questionnaire. Completed questionnaires were returned to the UK and entered into a database for analysis using SPSS v17. At this stage, 43 questionnaires were excluded due to participants being outside of the target age or nationality range, questionnaires being incomplete or illegible, or data being clearly inconsistent, leaving a final sample of 838 (Netherlands n = 204; Slovenia n = 221; Spain n = 191; UK n = 222).

The questionnaire recorded alcohol use by detailing the number of standard and large drinks of lager/beer, cider, wine, alcopops and spirits participants had consumed by interview, and expected to consume over the remainder of the night. For analysis, drinks were converted to grams of alcohol using an online conversion tool [29]. To account for differences in alcohol strengths and serving sizes across sites, conversions were based on typical standard/large drink sizes and alcohol strengths in each country (with information obtained via research leads or published literature [30]). Thus, the gram value used for drink types varied between locations with, for example, a standard glass of wine coded as 16.8 g of alcohol in Slovenia and the UK, 11.2 g in Spain and 9.6 g in the Netherlands. For analysis, breath alcohol concentration was converted to the more commonly used blood alcohol concentration (%BAC; milligrams of alcohol per 100 ml of blood) according to established UK ratios [31]. Analysis used chi squared, Kruskal Wallace and logistic regression. Ethical approval for the study was obtained from Liverpool John Moores University research ethics committee in the UK.

## Results

A greater proportion of males were surveyed in the Netherlands, Slovenia and Spain, and younger samples obtained in Spain and the UK (Table 1). In each location, over three quarters of participants had started drinking at least 3 h before interview. Around half in the Netherlands and UK had been in the nightlife environment for < 3 h when interviewed, whilst most in Slovenia and Spain had been out for at least 3 h. Based on participants' expected home time, the Dutch sample reported the shortest expected total stay in the nightlife environment (59.5% < 5 h).

Over half of Dutch (56.2%) and British (61.4%) participants had preloaded on the survey night. In Spain, 25.7% reported such preloading, yet a further 33.9% reported having participated in botellón (group drinking of off-licensed alcohol in public settings). As botellón can be a form of preloading in those attending bars and nightclubs, these Figures were combined to give the Spanish sample preloading levels similar to those in UK and Netherlands, with levels significantly lower in Slovenia (34.8%). Gender differences in preloading were only significant in the UK, where females reported higher levels than males (Table 2).

For females, there were no differences between nationalities in the median grams of alcohol participants reported having consumed by the point of interview (range 50.4 g to 56.8 g; Table 2). However, median BAC at interview varied significantly, being lowest in Slovenia (0.05%BAC) and highest in the UK (0.10%BAC). Among males, both reported grams consumed and BAC varied significantly, with both being highest in the UK (Table 2). In all countries, median grams of alcohol consumed by interview were significantly higher in males than females. Gender differences in BAC were significant in all countries except Spain.

To account for varying interview times, alcohol consumption and BAC were analysed by the length of time between participants' first alcoholic drink that day and their survey participation (Figures 1 and 2). For both sexes, in the shortest time category (drinking < 3 h at interview) there were no significant differences between

**Table 1 Participant demographics and nightlife characteristics at the point of survey**

| | | Netherlands | Slovenia | Spain | UK | P |
|---|---|---|---|---|---|---|
| | n | 204 | 221 | 191 | 222 | |
| Gender (%) | Male | 60.3 | 59.7 | 64.7 | 46.8 | |
| | Female | 39.7 | 40.3 | 35.3 | 53.2 | 0.002 |
| | n | 204 | 221 | 187 | 222 | |
| Age Group (%) | 16-19 | 15.7 | 15.8 | 33.0 | 30.2 | |
| | 20-24 | 45.6 | 42.1 | 33.5 | 45.0 | |
| | 25-35 | 38.7 | 42.1 | 33.5 | 24.8 | < 0.001 |
| | n | 204 | 221 | 191 | 222 | |
| Hours since first drink at interview (%) | Less than 3 hours | 20.8 | 24.9 | 22.9 | 24.8 | |
| | 3 to 5 hours | 39.1 | 46.9 | 54.7 | 40.5 | |
| | More than 5 hours | 40.1 | 28.2 | 22.4 | 34.8 | 0.007 |
| | n | 192 | 213 | 170 | 210 | |
| Hours in nightlife setting at interview (%) | Less than 3 hours | 54.7 | 25.2 | 13.9 | 51.4 | |
| | 3 to 5 hours | 25.8 | 46.3 | 53.9 | 28.1 | |
| | More than 5 hours | 19.5 | 28.5 | 32.2 | 20.5 | < 0.001 |
| | n | 190 | 214 | 180 | 210 | |
| Expected total hours in nightlife setting (%) | Less than 3 hours | 17.4 | 4.2 | 0.7 | 4.2 | |
| | 3 to < 5 hours | 42.1 | 34.1 | 30.3 | 42.1 | |
| | 5 to < 7 hours | 22.1 | 28.5 | 40.1 | 23.1 | |
| | More than 7 hours | 18.5 | 33.2 | 28.9 | 30.6 | < 0.001 |
| | n | 195 | 214 | 152 | 216 | |

nationalities in median grams of alcohol consumed by interview or in BAC. There were also no gender differences within countries. In all samples, self-reported consumption by interview increased in those who had been drinking for longer, yet this increase was most pronounced in UK samples (Figure 1). Correspondingly, UK participants of both sexes measured significant increases in median BAC as length of time since the first drink increased (Figure 2). Males from the Netherlands and Slovenia also saw increases in BAC with time spent drinking, yet these increases were largely between the first and second time drinking categories. There were no differences in BAC by time drinking in females of other nationalities.

Analysis by interview hour found that median BAC in UK females exceeded 0.08% in those interviewed at 11.00-11.59 pm, and continued to increase up to the final UK survey hour of 2.00-2.59 am, where median BAC reached 0.16%. Similar increases were seen in UK males, with median BAC exceeding 0.10% at 11.00-11.59 pm and reaching 0.19% by 2.00-2.59 am. Among females of other nationalities, median BAC did not increase with interview time and reached 0.08% only in Dutch females surveyed at 2.00-2.59 am. In non-UK males, the highest median%BAC was seen in Slovenia at 2.00-2.59 pm (0.12%). The Spanish team interviewed latest into the night and here median BAC remained under 0.08% even in those surveyed from 4.00 to 5.00 am. Logistic

regression was used to identify demographic and drink choice factors independently associated with high BAC (> 0.08%; the highest legal driving limit across the four study countries (UK) and a commonly used indicator of intoxication [32,33]). High BAC was associated with being male, aged > 19, British, having been drinking for longer at interview, and having consumed spirits prior to interview (Table 3).

Spirits were among the most common drinks reported by participants from the UK, Spain and Slovenia (Table 2). However, Dutch participants more commonly drank beer and, for females, wine. Among UK females and both sexes from Spain, spirits accounted for over half of all grams of alcohol consumed by interview. Beer accounted for the majority of grams consumed by Dutch males, and over half of those consumed by British males.

British participants expected to drink the most additional alcohol over the remainder of their night out, although differences between nationalities were only significant for males. These expected grams of alcohol were added to those participants reported having already consumed to give an estimate of total alcohol use on the survey night. For both sexes, this was highest in the UK, reaching a median of 104.8 g for females and 176.8 g for males. It was lowest in Slovenia, where median total grams remained < 70 g for females and < 80 g for males. In both Slovenia and Spain, total grams did not vary by gender. Median total grams in Dutch males was closer to

**Table 2 Alcohol consumption and %BAC at interview and total expected alcohol consumption on the night out**

| | | Females | | | | | Males | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Netherlands | Slovenia | Spain | UK | P[a] | Netherlands | Slovenia | Spain | UK | P[a] |
| **% having preloaded** (including botellón in Spain[b]) | | 58.8 | 38.2 | 59.0 | 70.3 | < 0.001 | 54.5 | 32.6 | 60.5 | 51.0 | < 0.001 |
| **Median grams of alcohol reported to have been consumed by interview** | | 54.4 | 50.4 | 50.4 | 56.8 | 0.147 | 92.8 | 64.0 | 70.4 | 104.0 | < 0.001 |
| **% having consumed drink type by interview** | Lager/Beer | 55.6 | 32.6 | 21.2 | 16.1 | < 0.001 | 85.4 | 56.1 | 40.5 | 75.0 | < 0.001 |
| | Cider | 1.2 | 0 | 0 | 9.3 | < 0.001 | 0.8 | 0 | 0 | 14.4 | < 0.001 |
| | Wine | 60.5 | 46.1 | 22.7 | 28.8 | < 0.001 | 9.8 | 25.8 | 9.1 | 7.7 | < 0.001 |
| | Alcopops | 9.9 | 1.1 | 30.3 | 16.1 | < 0.001 | 7.3 | 1.5 | 28.1 | 5.8 | < 0.001 |
| | Spirits | 35.8 | 59.6 | 71.2 | 85.6 | < 0.001 | 26.8 | 58.3 | 74.4 | 71.2 | < 0.001 |
| **% of grams of alcohol reported by overall sample accounted for by drink type[c]** | Lager/Beer | 39.6 | 17.2 | 14.0 | 12.0 | | 79.2 | 35.2 | 20.8 | 53.1 | |
| | Cider | 0.5 | 0.0 | 0.0 | 4.9 | | 1.1 | 0.0 | 0.0 | 8.2 | |
| | Wine | 37.6 | 45.8 | 11.8 | 20.7 | | 3.4 | 24.6 | 3.8 | 3.8 | |
| | Alcopops | 3.5 | 0.5 | 9.6 | 5.9 | | 2.0 | 0.9 | 12.1 | 1.2 | |
| | Spirits | 18.8 | 36.5 | 64.7 | 56.5 | | 14.3 | 39.3 | 63.3 | 33.6 | |
| **Median %BAC[d] at interview** | | 0.07 | 0.05 | 0.06 | 0.10 | < 0.001 | 0.09 | 0.08 | 0.07 | 0.13 | < 0.001 |
| **% with BAC > 0.08%** | | 34.6 | 34.8 | 34.8 | 58.5 | < 0.001 | 58.7 | 50.8 | 47.1 | 70.9 | 0.002 |
| **Median expected grams of alcohol to be consumed over the remainder of the night[e]** | | 22.4 | 17.6 | 16.8 | 40.0 | < 0.001 | 33.6 | 18.4 | 16.8 | 62.4 | < 0.001 |
| **Median grams of alcohol over whole night[f]** | | 76.8 | 66.4 | 72.0 | 104.8 | < 0.001 | 139.2 | 79.2 | 87.2 | 176.8 | < 0.001 |
| **% expecting to binge drink[g]** | | 80.5 | 67.9 | 63.8 | 82.5 | 0.026 | 85.8 | 61.6 | 72.3 | 96.0 | < 0.001 |

Statistics use chi squared and Kruskal-Wallis. Missing data: preloading n = 13; drinks types/grams of alcohol at interview n = 9; BAC n = 3.
[a]P between locations; [b]Spain: males 24.4% preload, 36.1% botellón, females 27.9% preload, 31.1% botellón. [c]Total grams of alcohol consumed by interview for individuals within each category were summed by drink type to show the proportion of grams reported by the sample that was accounted for by different drink types. [d] milligrams of alcohol per 100 millilitres of blood; legal driving limits are 0.08%BAC in the UK and 0.05% BAC in Netherlands, Slovenia and Spain. [e] Limited to the 691 individuals who were able to provide an estimate. [f] Including grams of alcohol consumed by interview and expected additional grams over the remainder of the night. [g]Sum of grams consumed by interview and expected additional grams over the remainder of the night greater than 48.0 grams for females and 64.0 grams for males.
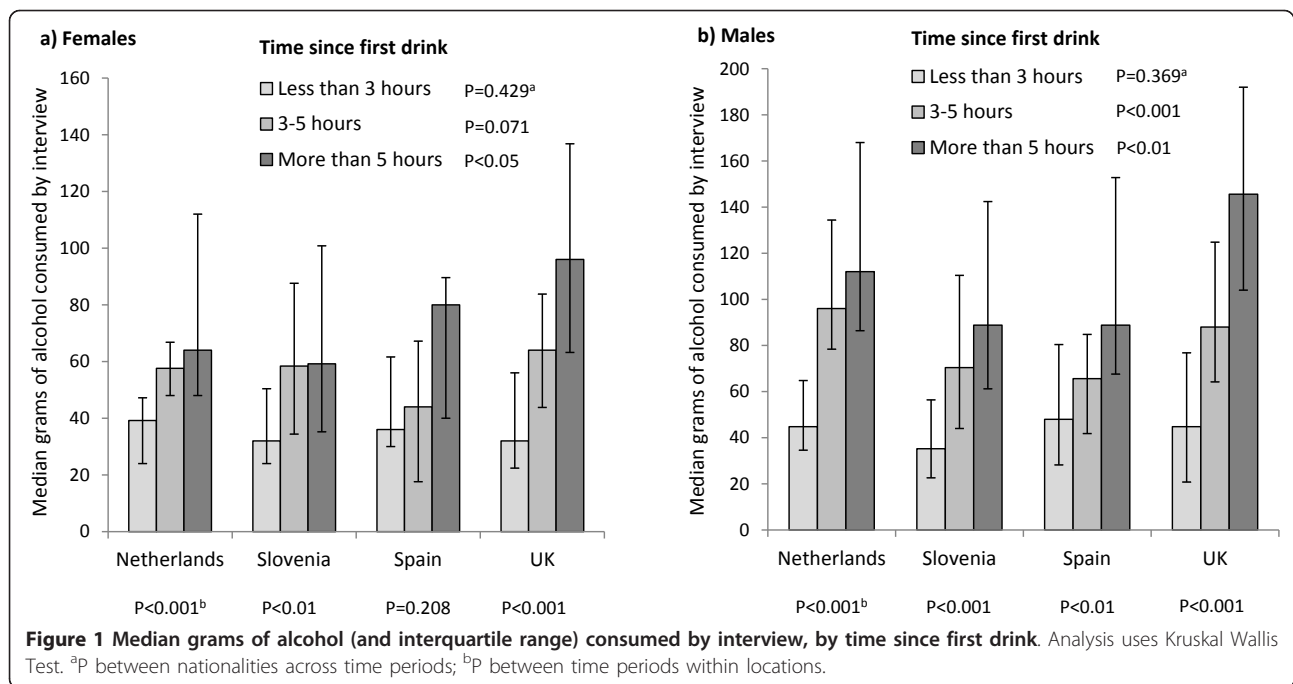
that in British males (Table 2), yet in Dutch females median total grams was more akin to that in females from Spain and Slovenia. In all samples, consuming the total expected grams would have meant most participants drank enough to constitute binge drinking (here defined as drinking > 6 [female] or > 8 [male] UK units of alcohol in one session [11], equivalent to > 48 g of alcohol for females and > 64 g for males; range 61.6% of males in Slovenia to 96.0% of males in the UK).

In addition to alcohol consumption, 10.7% of the sample reported having used, or intending to use, illicit drugs on the night of survey, predominantly cannabis (73.3%) followed by cocaine (30.2%). Drug use was most commonly reported by Spanish participants (21.3%, compared with 6.0%, 8.1% and 9.0% in the Dutch, British and Slovenian samples respectively).

## Discussion

Our study faced a number of limitations beyond those common to nightlife research [18,34]. Differences in nightlife habits meant that interviews were not conducted at consistent times in each study site but rather were targeted at the busiest periods in each city. Thus, we did not attempt to recruit representative samples of nightlife users but rather prospective samples indicative of the range of individuals participating in recreational drinking at peak times. With study implementation limited to one city in each country, sample sizes relatively small and overall compliance at 58.9%, findings should only be extrapolated with caution.

Recording alcohol consumption across four cultures was complicated by variations in alcoholic drink types and measures. Thus, we recorded the numbers of

**Figure 1 Median grams of alcohol (and interquartile range) consumed by interview, by time since first drink**. Analysis uses Kruskal Wallis Test. [a]P between nationalities across time periods; [b]P between time periods within locations.

different drinks individuals reported in two size categories and converted these to grams of alcohol based on local standard drink sizes and strengths. The reliability of alcohol estimates will be further constrained by variations in self-poured alcohol consumed during preloading [35] and recall issues [34]. Studies suggest that heavier drinkers can be more likely to underestimate their alcohol consumption [36,37], an effect potentially seen

among UK participants in our study. Thus, UK females reported a similar median of grams of alcohol at interview to females of other nationalities but had significantly higher median BAC, suggesting that alcohol use may have been under-reported (Table 2). The use of breathalysers provided a mechanism for recording a more comparable measure of intoxication across cities, although the same BAC can have different effects on



**Figure 2 Median %BAC (and interquartile range) measured at interview by time since first drink**. Analysis uses Kruskal Wallis Test. [a]P between nationalities across time periods; [b]P between time periods.
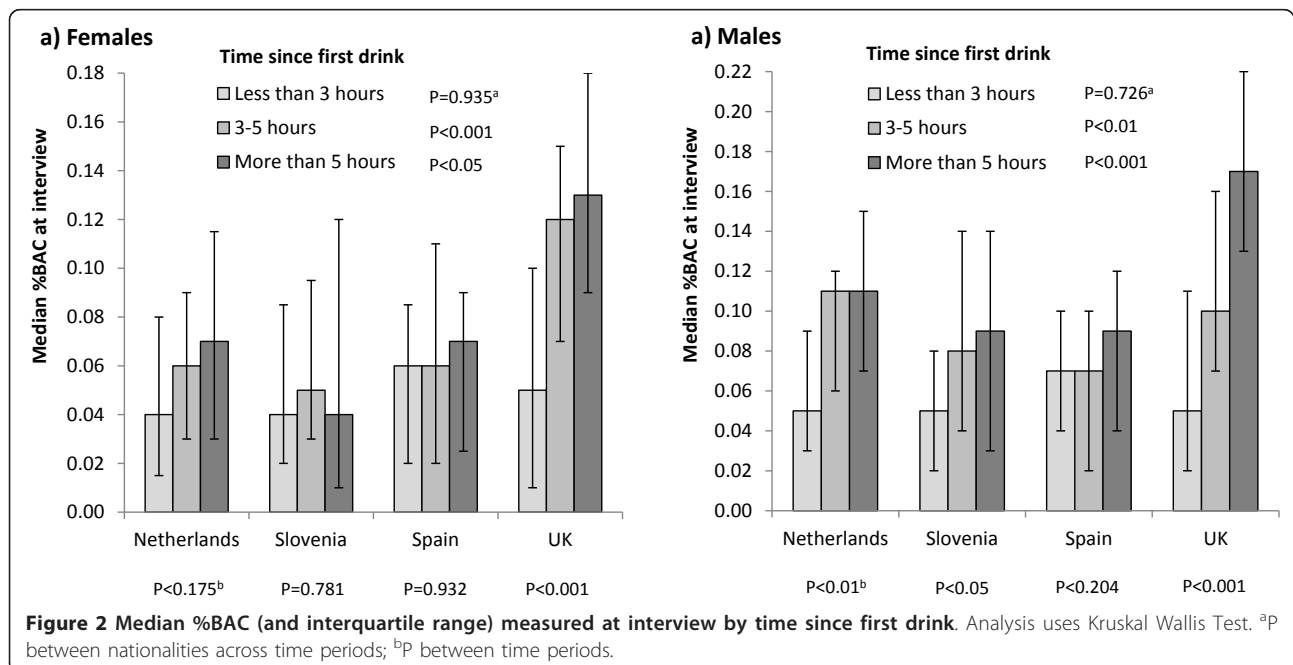
**Table 3 Adjusted odds ratios (AOR) for high blood alcohol concentration (> 0.08%BAC) at interview**

| | | AOR | 95%CIs | P |
|---|---|---|---|---|
| Gender | Female (Ref) | | | * |
| | Male | 1.53 | 1.07-2.19 | |
| Age Group | 16-19 (Ref) | | | *** |
| | 20-24 | 2.50 | 1.66-3.78 | |
| | 25-35 | 1.96 | 1.28-3.01 | |
| Country | Slovenia (Ref) | | | ** |
| | Spain | 0.89 | 0.54-1.46 | |
| | Netherlands | 1.17 | 0.75-1.83 | |
| | UK | 2.26 | 1.43-3.58 | |
| Time spent drinking by point of interview | Less than 3 hours (Ref) | | | *** |
| | 3 to 5 hours | 2.26 | 1.50-3.41 | |
| | More than 5 hours | 3.62 | 2.28-5.74 | |
| Preloaded (or botellón) | No (Ref) | | | 0.185 |
| | Yes | 1.25 | 0.90-1.73 | |
| Consumed prior to interview: | | | | |
| Lager/Beer | No (Ref) | | | 0.227 |
| | Yes | 1.26 | 0.87-1.85 | |
| Cider | No (Ref) | | | 0.601 |
| | Yes | 1.30 | 0.49-3.46 | |
| Wine | No (Ref) | | | 0.700 |
| | Yes | 0.92 | 0.61-1.39 | |
| Alcopops | No (Ref) | | | 0.851 |
| | Yes | 1.06 | 0.60-1.86 | |
| Spirits | No (Ref) | | | * |
| | Yes | 1.59 | 1.07-2.34 | |
| Had or intended to use illicit drugs on survey night | No (Ref) | | | 0.876 |
| | Yes | 0.96 | 0.57-1.62 | |

*P < 0.05, **P < 0.01, ***P < 0.001; 95%CIs = 95% confidence intervals

Analysis uses logistic regression with all shown demographic and nightlife variables entered into the model. Missing data values limited the sample to 750.

different people and consequently BAC is not a reliable measure of drunkenness [34]. Further, individuals who were severely intoxicated were excluded to meet ethical requirements, meaning median reported alcohol consumption and BAC are likely to be underestimated. Despite training researchers in identifying such individuals for exclusion, differences in researchers' cultural and personal perceptions of intoxication may have introduced further bias to the samples obtained. However, even in Spain where the number excluded was highest, such individuals represented only 5.8% of potential participants. Finally, the validity of responses to questions on expected behaviours (alcohol use, home time) post survey could not be verified in our study, and in particular several participants (n = 147, 17.5%) felt unable to provide an estimate of how much additional alcohol they would consume that night.

This investigation into drinking behaviours in European nightlife found high levels of alcohol consumption in all cities. The majority of individuals reported consumption equivalent to levels commonly used to measure binge drinking [11], and by the point of interview median reported alcohol consumption had already reached binge drinking levels for both sexes, with many individuals intending to continue drinking. Despite screening out those assessed as too drunk to participate in the survey, 56.2% of all males and 42.7% of all females had BACs greater than 0.08%. However, significant differences were seen between nationalities in most measures of alcohol use. Specifically, participants from the UK had significantly higher BACs at interview and expected to consume the greatest total grams of alcohol across the course of their night out (Table 2). In line with the characterised north-south divide in drinking cultures in Europe [10], the lowest BACs and expected consumption levels were seen in the southern countries (Slovenia and Spain). In all countries, reported alcohol use and BAC were higher in males than in females, although differences were not always significant.

A range of studies have documented the high levels of alcohol use and intoxication in UK nightlife users

[18,23]. Cross-national studies have suggested they are also at increased risk of social harms associated with their drinking, particularly violence [11]. This culture of intoxication is clearly apparent in our study, with findings indicating that many UK nightlife users fail to moderate their drinking across a night out. Thus, whilst BAC and grams of alcohol consumed by interview in individuals from the Netherlands, Slovenia and Spain increased more moderately or not at all with the time spent drinking, in UK participants both continued to increase on a substantially steeper trajectory. Further, median %BAC increased with interview time in UK respondents, with both genders exceeding a median of 0.08%BAC by the 11.00-11.59 pm time period and reaching at least double this level by 2.00-2.59 am. Notably, median BAC at interview was higher in UK females than that of males of other nationalities. These findings are consistent with UK nightlife being a considerably more intoxicated environment than that in other European countries.

There is a growing evidence base on the effectiveness of strategies to reduce alcohol-related harm in drinking environments. Studies suggest that measures including targeted enforcement in venues associated with alcohol-related problems and bar staff training can be effective, particularly when integrated into broader, multi-agency programmes that mobilise communities into co-ordinated action [38,39]. Regulatory measures that reduce the availability of alcohol through, for example, restrictions on alcohol outlet density and increased alcohol price, are also likely to have significant effect but are rarely used in practice [40]. However, most evidence on the effectiveness of interventions in drinking environments stems from studies outside of Europe (North America and Australia), with European evidence limited largely to studies in northern European countries (UK and Scandinavian countries [9,38]). These interventions are often designed to reduce alcohol-related crime and violence in cultures of intoxication. Such interventions may not be appropriate to tackle the smaller proportion of individuals drinking heavily in other countries. A study of nightlife risk behaviours in young Europeans suggested that drink driving may be a particular issue for those from southern countries [12,41].

Strategies to reduce alcohol-related harm in drinking environments should not limit their attention to on-licensed alcohol consumption. Preloading has been identified as a major feature of nightlife participation in several countries [36,42-44], and has been associated with greater alcohol consumption in nightlife users as well as involvement in violence [23,44]. No independent associations were found between preloading and high BAC in our study, although preloading was found to be widespread. Over half of participants of both genders from the UK, Netherlands and Spain, and a third from Slovenia, had

consumed alcohol before going to bars and nightclubs on the survey night. Gender differences in preloading were only significant in the UK, where females reported higher levels than males. Preloading can be undertaken for a variety of reasons including to save money (through consumption of cheaper off-licensed alcohol), to achieve drunkenness and to socialise with friends. This latter reason may be particularly important for British females, for whom the act of getting ready to go out is often a protracted social process that can itself form a key part of the night out [45]. Although the drivers behind female preloading in the UK have yet to be fully explored [46], factors around safety, confidence and group bonding may also be important for young women preparing to visit an environment perceived as sexually and physically aggressive. These issues require further research, as do the lower levels of preloading identified among the sample from Slovenia.

In Spanish participants, around half of those classed as preloaders had participated in botellón, a phenomenon of drinking in public places that has become increasingly widespread among Spanish youth and is appearing in other southern European countries (e.g. Portugal [47]). Like preloading in other settings (e.g. homes, college residences [43]), a key reason for participation in botellón is the lower price of off-licensed alcohol compared with that in bars and nightclubs [26]. Preloading with off-licensed alcohol can mean that bars and nightclubs face an increasingly intoxicated customer base, which is likely to hamper strategies that aim to reduce harm in drinking environments through, for example, promoting responsible beverage service and bar management.

Studies of the Spanish botellón and youth drinking elsewhere in Europe are noting a shift in the type of alcohol consumed by young people in southern Europe, characterised by greater beer and spirits consumption [14,48]. Across Europe in general, traditional preferences (particularly among males) for wine in southern countries and beer or spirits in northern countries [4,10] have diminished in recent years, although wine and beer continue to account for the greatest share of alcohol use in most southern and northern countries respectively. In 2002, spirits were found to account for less than a third of alcohol consumption across each of the 15 European Union countries and Norway [4]. In contrast, our study of young adults in nightlife environments found a preference towards spirits in both sexes from all participating countries except the sample from the Netherlands. In particular, over 70% of Spanish participants had consumed spirits prior to interview, with spirits accounting for almost two thirds of all grams of alcohol consumed by the Spanish sample. Although spirits are often consumed during botellón [48], spirits consumption was most common in those who had only consumed alcohol

in bars and nightclubs (83.1%, compared with 64.4% of botellón participants and 74.5% of pre-drinkers, $P < 0.05$). Spirits increase BAC more rapidly than consumption of other drink types [49] and have been associated with greater alcohol consumption, more frequent risky drinking occasions, and drinking motives focused on fun and drunkenness [50]. In our study, consumption of spirits was independently associated with having a BAC > 0.08% at interview. The strong preference for spirits in our samples thus provides support for a growing normalisation of intoxication among young Europeans.

Drinking behaviours in European nightlife settings will be influenced by a range of social, cultural, economic and environmental factors, including the availability and affordability of alcohol. For example, although findings are mixed, studies suggest that greater density of alcohol outlets and longer opening hours are associated with increased alcohol use and related harms [51,52]. The price of alcohol also has a strong influence, particularly in young people, and studies show that alcohol has become more affordable in most European countries over recent years [53]. However, national economic analyses say little about local conditions, and factors including cheap drinks promotions in nightlife venues and large discrepancies between on and off licensed alcohol prices will impact on how and where young people drink over the course of a night out. Equally, the drinking environment in licensed premises (e.g. crowding, poor cleanliness), bar manager and staff practice (e.g. service of alcohol to drunk customers), and local alcohol policy and enforcement activity (e.g. policing of problem premises, punishment of sales of alcohol to minors) may all affect drinking behaviours and alcohol-related harm [22,38]. There is currently a lack of data on such factors within different European drinking environments and whether they are driving the differences in drinking patterns identified in this study.

## Conclusions

This study has provided an examination of drinking behaviours and BAC among young people in four European drinking environments. High levels of preloading and alcohol use were seen in nightlife in all cities. Excessive alcohol use can lead to a wide range of health and social harms, including violence and unintentional injury, risky sexual behaviour, anti-social behaviour, and poor educational and work performance. Critically, occasional heavy drinking sessions also increase an individual's risk of later mortality through an alcohol-related disease [54]. With alcohol already a leading cause of death in young Europeans [55], the high levels of alcohol use seen in our study emphasise the need for co-ordinated strategies to reduce harm in drinking environments. However, while a wide range of drinking patterns was present in all cities studied, those in Spain, Slovenia and the Netherlands

were largely characterised by steady, more moderate intoxication compared with escalating inebriation in the UK. As drinking patterns, alcohol policy and commercial interests converge across Europe, the challenge for public health is to ensure that models of escalating inebriation in nightlife environments are replaced rather than replicated.

## Endnotes

[1]Data on drinking environments were obtained by research partners from the relevant authorities in each city.

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## Authors' contributions

KH designed the study, participated in data collection, analysed the data and wrote the manuscript. ZQ co-designed the study, managed study implementation, participated in data collection, and edited the manuscript. MB contributed to study design, data analyses and writing of the manuscript. NvH, AC, MK, MJ, MD and LV contributed to study design, study implementation and data collection and edited the manuscript. All authors read and approved the final manuscript.

## Competing interests

In the past 5 years, Centre for Public Health received a grant from Drinkaware to undertake an independent study of drinking behaviours among students and MAB has provided them with independent medical advice. Drinkaware is an independent UK-wide charity supported by voluntary contributions from the alcohol and supermaket industries.

## References

1. World Health Organization: *Global strategy to reduce the harmful use of alcohol* Geneva; 2010.
2. Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, Patra J: **Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders.** *Lancet* 2009, **373**:2223-2233.
3. Rehm J, Taylor B, Patra J: **Volume of alcohol consumption, patterns of drinking and burden of disease in the European region 2002.** *Addiction* 2006, **101**:1086-1095.
4. Anderson P, Baumberg A: *Alcohol in Europe: a public health perspective* London: Institute of Alcohol Studies; 2006.

5.   Rehm J, Zatonksi W, Taylor B, Anderson P: **Epidemiology and alcohol policy in Europe.** *Addiction* 2011, **106**(S1):11-19.
6.   Taylor B, Irving HM, Kanteres F, Room R, Borges G, Cherpitel C, *et al*: **The more you drink, the harder you fall: a systematic review and meta-analysis of how acute alcohol consumption and injury or collision risk increase together.** *Drug Alcohol Depend* 2010, **110**:108-116.
7.   Gmel G, Bissery A, Gammeter R, Givel J-C, Calmes J-M, Yersin B, *et al*: **Alcohol-attributable injuries in admissions to a Swiss emergency room– an analysis between volume of drinking, drinking patterns and preattendance drinking.** *Alcohol Clin Exp Res* 2006, **30**:501-509.
8.   Gmel G, Kuntsche E, Rehm J: **Risky single-occasion drinking: bingeing is not bingeing.** *Addiction* 2010, **106**:1037-1045.
9.   Hughes K, Furness L, Jones L, Bellis MA: *Reducing harm in drinking environments: evidence and practice in Europe* Liverpool: Centre for Public Health, Liverpool John Moores University; 2010.
10.  Makela P, Gmel G, Grittner U, Kuendig H, Kuntsche S, Bloomfield K, *et al*: **Drinking patterns and their gender differences in Europe.** *Alcohol Alcohol* 2006, **41**(S1):i8-i18.
11.  Plant MA, Plant ML, Miller P, Gmel G, Kuntsche S: **The social consequences of binge drinking: a comparison of young adults in six European countries.** *J Addict Dis* 2009, **28**:294-308.
12.  Calafat A, Blay NT, Hughes K, Bellis MA, Juan M, Duch M, *et al*: **Nightlife young risk behaviours in Mediterranean versus other European cities: are stereotypes true?** *Eur J Public Health* , doi:10.1093/eurpub/ckq141.
13.  Hibell B, Guttormsson U, Ahlstrom S, Balakireva O, Bjarnason T, Kokkevi A, *et al*: *The 2007 ESPAD report: substance use among students in 35 European countries* Stockholm: The Swedish Council for Information on Alcohol and other Drugs; 2009.
14.  Jarvinen M, Room R: *Youth drinking cultures: European experiences* Aldershot: Ashgate; 2007.
15.  Currie C, Gabhainn SN, Godeau E, Roberts C, Smith R, Currie D, *et al*: *Inequalities in young people's health: HBSC international report from the 2005/ 2006 survey* Copenhagen: World Health Organization Regional Office for Europe; 2008.
16.  Bellis MA, Hughes K, Cook PA, Morleo M: *Off measure: how we underestimate how much we drink* London: Alcohol Concern; 2009.
17.  Nelson DE, Naimi TS, Brewer RD, Roeber J: **US state alcohol sales compared to survey data, 1993-2006.** *Addiction* 2010, **105**:1589-1596.
18.  Bellis MA, Hughes K, Quigg Z, Morleo M, Jarman I, Lisboa P: **Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation.** *Subst Abuse Treat Prev Policy* 2010, **5**:5.
19.  Moore S, Shepherd J, Perham N, Cusens B: **The prevalence of alcohol intoxication in the night-time economy.** *Alcohol Alcohol* 2007, **42**:629-634.
20.  Glindemann KE, Wiegand DM, Geller ES: **Celebratory drinking and intoxication: a contextual influence on alcohol consumption.** *Environ Behav* 2007, **39**:352-366.
21.  Clapp JD, Reed MB, Min JW, Shillington AM, Croff JM, Holmes MR, *et al*: **Blood alcohol concentrations among bar patrons: a multi-level study of drinking behavior.** *Drug Alcohol Depend* 2009, **102**:41-48.
22.  Hughes K, Quigg Z, Eckley L, Bellis MA, Jones L, Calafat A, *et al*: **Environmental factors in drinking venues and alcohol-related harm: the evidence base for European intervention.** *Addiction* 2011, **106**(S1):37-46.
23.  Hughes K, Anderson Z, Morleo M, Bellis MA: **Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes.** *Addiction* 2008, **103**:60-65.
24.  Bellis MA, Hughes K: **Getting drunk safely? Nightlife policy in the UK and its public health consequences.** *Drug Alcohol Rev* 2011, **30**:536-545.
25.  van Calster P, van der Leun J, van Hasselt N: **The Netherlands.** *Nightlife and crime: social order and governance in international perspective* Edited by Hadfield P. Oxford: Oxford University Press; 2009.
26.  Calafat A, Juan M, Becona E, Castillo A, Fernandez C, Franco M, *et al*: **El consumo de alcohol en la logica del botellon.** *Adicciones* 2005, **17**:193-202.
27.  Danielsson A-K, Wennberg P, Hibell B, Romelsjö A: **Alcohol use, heavy episodic drinking, and subsequent problems among adolescents in 23 European countries: does the prevention paradox apply?** *Addiction* , postprint, doi: 10.1111/j.1360-0443.2011.03537.x.
28.  IREFREA: *Recreational-prev: survey report* Palma: IREFREA; 2006.
29.  Drinkaware: **Unit Calculator.**[http://www.drinkaware.co.uk/tips-and-tools/ drink-diary/].
30.  Gual A, Martos AR, Lligona A, Llopis JJ: **Does the concept of a standard drink apply to viticultural societies?** *Alcohol Alcohol* 1999, **34**:153-160.
31.  *Transport Act 1981* London: Her Majesty's Stationery Office; 1981.
32.  Shanin H, Gopinath SP, Robertson CS: **Influence of alcohol on early Glasgow Coma Scale in head-injured patients.** *J Trauma* 2010, **69**:1176-1181.
33.  Hopthrow T, Abrams D, Frings D, Hulbert LG: **Groupdrink: the effects of alcohol on intergroup competitiveness.** *Psychol Addict Behav* 2007, **21**:272-276.
34.  Aldridge J, Charles V: **Researching the intoxicated: informed consent implications for alcohol and drug research.** *Drug Alcohol Depend* 2008, **93**:191-196.
35.  Gill JS, Donaghy M: **Variation in the alcohol content of a 'drink' of wine and spirit poured by a sample of the Scottish population.** *Health Educ Res* 2004, **19**:485-491.
36.  Townshend JM, Duka T: **Patterns of alcohol drinking in a population of young social drinkers: a comparison of questionnaire and diary measures.** *Alcohol Alcohol* 2002, **37**:187-192.
37.  Grant S, LaBrie JW, Hummer JF, Lac A: **How drunk am I? Misperceiving one's level of intoxication in the college drinking environment.** *Psychol Addict Behav* 2011, doi: 10.1037/a0023942.
38.  Jones L, Hughes K, Atkinson A, Bellis MA: **Reducing harm in drinking environments: a systematic review of effective approaches.** *Health Place* 2011, **17**:508-518.
39.  Graham K, Homel R: *Raising the bar: preventing aggression in and around bars, pubs and clubs* Portland, OR: Willan Publishing; 2008.
40.  Hughes K, Bellis MA, Hughes S, Mikton C, Butchart A: *Preventing violence by reducing the availability and harmful use of alcohol* Geneva: World Health Organization; 2009.
41.  Calafat A, Blay N, Juan M, Adrover D, Bellis MA, Hughes K, *et al*: **Traffic risk behaviours at nightlife: drinking, taking drugs, driving and use of public transport by young people.** *Traffic Inj Prev* 2009, **10**:162-169.
42.  DeJong W, DeRicco B, Schneider SK: **Pregaming: an exploratory study of strategic drinking by college students in Pennsylvania.** *J Am Coll Health* 2010, **58**:307-316.
43.  Wells S, Graham K, Purcell J: **Policy implications of the widespread practice of 'pre-drinking' or 'pre-gaming' before going to public drinking establishments: are current prevention strategies backfiring?** *Addiction* 2009, **104**:4-9.
44.  Wahl S, Kriston L, Berner M: **Drinking before going out–a predictor of negative nightlife experiences in a German inner city area.** *Int J Drug Pol* 2010, **21**:251-254.
45.  Szmigin I, Bengry-Howell A, Griffin C, Hackley C, Mistral W: **Social marketing, individual responsibility and the "culture of intoxication".** *Eur J Marketing* 2011, **45**:759-779.
46.  Ritchie C, Ritchie F, Ward R: **A good night out: alcohol-related behaviours in young adults.** *Worldwide Hospitality and Tourism Themes* 2009, **1**:169-193.
47.  Sobral C: *Reportagem: viagem por uma noite de botellon em Lisboa Publico* 2011 [http://www.publico.pt/Sociedade/reportagem-viagem-por-uma-noite-de-botellon-em-lisboa_1488047].
48.  Tomas MTC, Tort BE, Costa JAG: **Caracteristicas que definen el fenomeno del botellon en universitarios y adolescentes.** *Adicciones* 2007, **19**:357-372.
49.  Smart RG, Walsh GW: **Do some type of alcoholic beverages lead to more problems for adolescents?** *J Stud Alcohol* 1995, **56**:35-38.
50.  Kuntsche E, Knibbe R, Gmel G, Engels R: **'I drink spirits to get drunk and block out my problems...' Beverage preference, drinking motives and alcohol use in adolescence.** *Alcohol Alcohol* 2006, **41**:566-573.
51.  Livingston M, Chikritzhs T, Room R: **Changing the density of alcohol outlets to reduce alcohol-related problems.** *Drug Alcohol Rev* 2007, **26**:557-566.
52.  Popova S, Giesbrecht N, Bekmuradov D, Patra J: **Hours and days of sale and density of alcohol outlets: impacts on alcohol consumption and damage: a systematic review.** *Alcohol Alcohol* 2009, **44**:500-516.
53.  Rabinovich L, Brutscher P-B, de Vries H, Tiessen J, Clift J, Reding A: *The affordability of alcoholic beverages in the European Union: understanding the link between alcohol affordability, consumption and harms* Santa Monica, CA: RAND Corporation; 2009.

54. Rehm J, Room R, Taylor B: **Method for moderation: measuring lifetime risk of alcohol-attributable mortality as a basis for drinking guidelines.** *Int J Methods Psychiatr Res* 2008, **17**:41-151.
55. World Health Organization: *Global burden of disease: global health risks summary tables* Geneva; 2009.

# Environmental factors in drinking venues and alcohol-related harm: the evidence base for European intervention

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## ABSTRACT

**Aims**   Reducing alcohol-related harm in young people is a major priority across Europe. Much alcohol use and associated harm in young people occurs in public drinking environments. This review aims to identity environmental factors in drinking establishements that are associated with increased alcohol consumption and associated harm and to understand the extent of study in this area across Europe. **Methods**   A systematic literature search identified studies that had explored associations between physical, staffing and social factors in drinking environments and increased alcohol use or alcohol-related harm. **Results**   Fifty-three papers were identified, covering 34 studies implemented in nine countries. Most studies had been implemented in non-European countries and many had collected data more than a decade prior to the review. The majority had used observational research techniques. Throughout the studies, a wide range of physical, staffing and social factors had been associated with higher levels of alcohol use and related harm in drinking environments. Factors that appeared particularly important in contributing to alcohol-related problems included a permissive environment, cheap alcohol availability, poor cleanliness, crowding, loud music, a focus on dancing and poor staff practice. However, findings were not always consistent across studies. **Conclusions**   Drinking establishments, their management and the behaviours of the young people who use them vary widely across Europe. While international research shows that environmental factors in drinking settings can have an important influence on alcohol-related harm, there is currently a scarcity of knowledge on the relevance and impacts of such factors in modern European settings. Developing this knowledge will support the implementation of strategies to create drinking environments in Europe that are less conducive to risky drinking and alcohol-related harm.

**Keywords**   Alcohol, alcohol-related harm, drinking environments, prevention, young people.

## INTRODUCTION

Reducing alcohol use and related harm in young people is a major European public health priority [1]. Young Europeans typically consume greater quantities of alcohol per drinking session than older drinkers [2], and many report binge drinking and drunkenness [3,4]. These drinking patterns are reflected in the disproportionate burden of alcohol-related harm seen in young Europeans. More than 25% of deaths in 15–29-year-old males and more than 10% in females are associated with alcohol use,

occurring largely through violence, road traffic crashes and unintentional injuries [5]. Although drinking patterns vary widely across Europe, many countries have seen increasing levels of hazardous and harmful alcohol consumption in young people in recent years [5]. Even in southern European countries such as Italy, Portugal and France, where drinking cultures have been characterized traditionally by daily, moderate consumption with meals [2], prevalence of heavy episodic drinking in 15–16-year-olds has increased over the last decade (five or more drinks on one occasion, as measured by the European

School Survey Project on Alcohol and other Drugs (ESPAD) survey[6]). This has raised concerns that drinking patterns associated typically with northern European cultures, including heavy alcohol use for the purpose of intoxication, are spreading across Europe [7].

Much alcohol use by young Europeans takes place in public drinking environments, such as pubs, bars and nightclubs (drinking venues) [8]. Well-managed drinking venues can provide some level of social protection for drinkers (e.g. preventing drunk customers from accessing more alcohol), yet at the same time the convergence of large numbers of drinkers in public places creates conditions conducive to harm (e.g. confrontation and encounters with aggressive strangers). Thus, public drinking environments see high levels of alcohol-related harm, including drunkenness, aggression, sexual assault, public disorder, unintentional injury, drink driving and road traffic crashes [9–14]. However, studies exploring alcohol-related harm in drinking environments often find that large proportions of incidents are concentrated in and around just a small proportion of drinking venues [15,16], suggesting that certain characteristics of these venues are contributing to alcohol-related problems. Thus, over the last few decades researchers have used a range of techniques to explore associations between environmental factors in drinking venues and alcohol use and related harm [17,18]. Among the most influential has been the work of Graham *et al.* [19–26] in Canada and Homel *et al.* [27–37] in Australia. Their research has facilitated the development of interventions to modify environmental factors in drinking environments to make them less conducive to alcohol-related harm [17]. Thus, staff training and venue risk assessment in Canada, and community prevention measures incorporating codes of practice for drinking venues in Australia, have achieved reductions in aggression occurring in drinking environments [17].

Similar prevention measures have been developed and implemented successfully in Europe [e.g. the Stockholm Prevents Alcohol and Drug Problems (STAD) project in Sweden [38–41]]. Overall, however, there is limited knowledge regarding alcohol-related harm in European drinking venues, what environmental factors may contribute to this and what can be done to reduce it [42]. With increasing hazardous and harmful drinking among young people, strengthening the European evidence base to inform the development of healthier drinking environments is crucial. This paper reports the findings from a systematic literature review undertaken as the first stage of a multi-country study of drinking environments in Europe. The Alcohol Measures for Public Health Research Alliance (AMPHORA) study is exploring environmental influences on alcohol use and related harm in pubs, bars and nightclubs in four European countries: the Nether-

lands, Slovenia, Spain and the United Kingdom. The systematic literature review sought to identify existing studies in this area and their outcomes, and particularly to understand the extent of study in this area across Europe.

## A SYSTEMATIC REVIEW OF THE LITERATURE

### Methods

Ten health, social sciences and education databases and 10 key websites (see Fig. 1) related to alcohol research were searched for studies published since 1990. A comprehensive search strategy was developed using a combination of free text and controlled English language vocabulary terms, and adapted for each database. Full details of the search strategy used are available on request from the authors. The combined searches retrieved 5114 papers. A database of retrieved literature was compiled using the Endnote software package. Following title review and removal of duplicates, 535 papers were identified for abstract review. Of these, 98 were selected for full text review. Database and website searches were supplemented by checking the reference lists of retrieved papers, relevant reviews and book chapters, identifying a further 34 studies. Full text could not be accessed for five papers, leaving a total of 127 papers that were examined for inclusion (see Fig. 1).

The literature review intended to identify published studies that had explored associations between environmental factors in drinking venues and alcohol-related harms. Consequently, a broad inclusion criterion was adopted covering any study type that linked environmental factors to drinking behaviours (e.g. drunkenness) and harms including injury, assault, road traffic crashes, crime and service of alcohol to underage or drunk customers. Descriptive studies that solely hypothesized links between environmental factors and harm were excluded [43], but qualitative studies in which researchers had observed the circumstances surrounding alcohol-related harm were included, even if no statistical analysis had been undertaken. The review focused on environmental factors that could be identifiable through naturalistic observational research (the method to be used in the present study) and modified locally through environmental interventions. Consequently, factors such as staff length of service and level of training [44], patron characteristics (e.g. age, ethnicity, individual activities, drinking group composition) [45–47], and factors dependent on regulation such as hours of alcohol service [48,49] were not included.

### RESULTS

A total of 53 papers were identified in the review, covering 34 studies conducted in nine countries: United States,
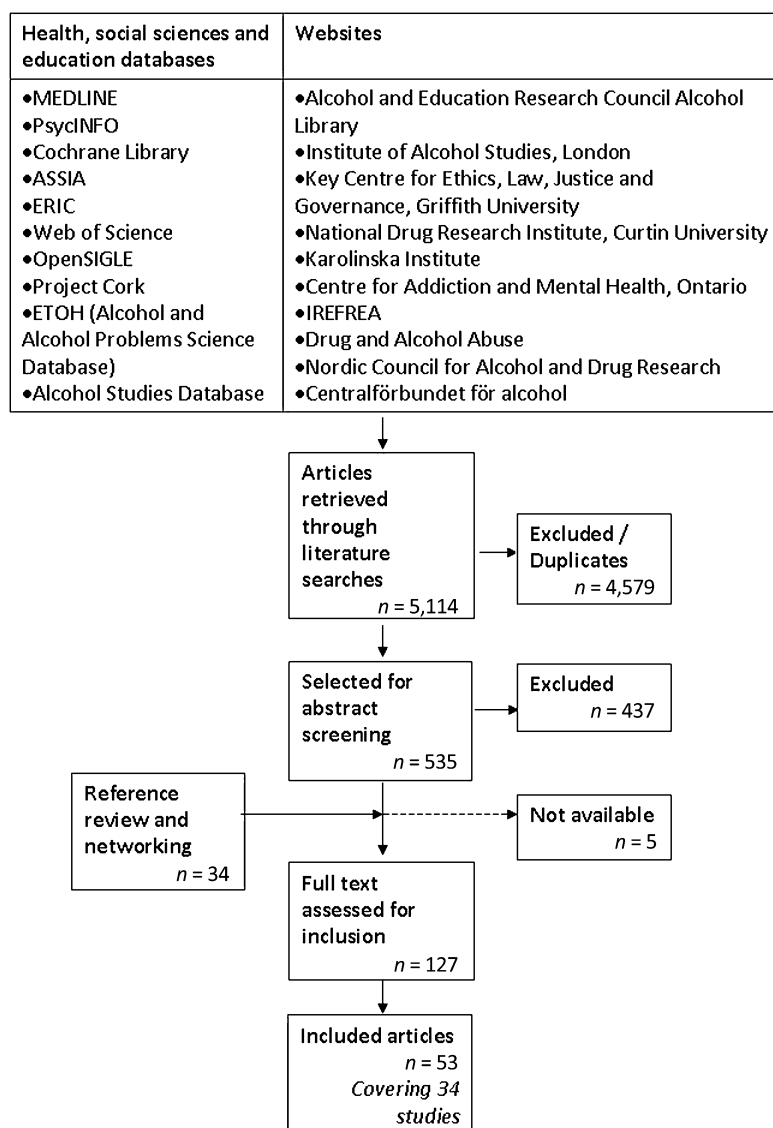
| Health, social sciences and education databases | Websites |
|---|---|
| •MEDLINE<br>•PsycINFO<br>•Cochrane Library<br>•ASSIA<br>•ERIC<br>•Web of Science<br>•OpenSIGLE<br>•Project Cork<br>•ETOH (Alcohol and Alcohol Problems Science Database)<br>•Alcohol Studies Database | •Alcohol and Education Research Council Alcohol Library<br>•Institute of Alcohol Studies, London<br>•Key Centre for Ethics, Law, Justice and Governance, Griffith University<br>•National Drug Research Institute, Curtin University<br>•Karolinska Institute<br>•Centre for Addiction and Mental Health, Ontario<br>•IREFREA<br>•Drug and Alcohol Abuse<br>•Nordic Council for Alcohol and Drug Research<br>•Centralförbundet för alcohol |



**Figure 1** Search strategy: literature sources and process

$n = 12$ [44,50–62]; Australia, $n = 8$ [27–37,48,49,63–65]; United Kingdom, $n = 5$ [66–70]; Canada, $n = 3$ [19–26]; France, $n = 2$ [71,72]; Bulgaria = 1 [73]; the Netherlands, $n = 1$ [45–47]; Spain, $n = 1$ [74]; and Sweden, $n = 1$ [39–41]. Two-thirds ($n = 22$) of the studies had used observational research techniques, often in combination with other research methods including qualitative interviews, survey data, secondary data analyses (e.g. police-recorded crime data), patron breathalyser tests and alcohol purchase attempts using pseudo-drunk actors. Most were naturalistic observations, although some included experimental techniques (e.g. adjusting music volume). Several studies had used similar research methods, incorporating tools initially developed by Graham *et al.* in Canada (e.g. [19–25,32–37,58,69, 70]). Other study types included retrospective surveys, cross-sectional and time-series analyses, experimental studies and randomized controlled trials.

The environmental factors identified in the studies as being associated with increased or reduced alcohol use and harm were grouped into three categories [17]: physical factors, social factors and staffing factors. Table 1 shows those environmental factors in drinking venues that have been associated with increased or reduced measures of alcohol use and access (higher consumption, intoxication, service to drunk or underage customers), and the countries in which these links have been identified. The review identified 13 studies in this area, five of which had been conducted in Europe. Six of the identified studies reported on data that had been collected over a decade prior to the review (1998 or earlier [20,45–47,50,51,63,64]), including three US studies and all studies from Australia, Canada and the Netherlands. Dates of data collection were not published for two French studies (published 2004 [71] and 2008 [72]). The Swedish study identified was conducted at

**Table 1** Environmental factors associated with alcohol use and service practices.

| Environmental factor | | USA | Australia | Canada | Netherlands | France | Sweden | Bulgaria |
|---|---|---|---|---|---|---|---|---|
| | | *Country in which links identified* | | | | | | |
| Physical factors | Poor ventilation | | | ↑● | | | | |
| | Poor cleanliness | | | ↑● | | | ◆[a] | |
| | Crowded venues | ↓◆ | | ↑● | | | ↓◆ | |
| | Crowded dance floors | ↑■[b] | | | | | | |
| | Noisy, loud music | | | ↑● | ↑▲ | ↑■ | ↓◆[c] | |
| | Lighting | ↑■[b] | | | | | | |
| | Venue style | ↓◆[d] ■[b] | | ↑●[e] | | | | |
| Social factors | Cheap drinks, drinks promotions | ↑•■ | | | | | | ↑✚[b] |
| | Permissive environment[f] | | | ↑● | | | ↓◆ | |
| | Live bands, juke boxes, discos, dancing | ↑■[b] | ↑■ | ↑● | ↑▲ | | | |
| | Food availability | | | ↓● | | | | |
| Staff factors | Younger staff | ↑◆ | | | | | | |
| | Friendly staff | | | ↓● | | | | |
| | All female staff | | | ↓● | | | | |
| | Warning signs, staff policies[g] | ↓◆ | | | | | | |
| | Continuing to serve drunk customers | | ↑■ | | | | | |
| References | | [44,50–54] | [63,64] | [20] | [45–47] | [71,72] | 39–41 | [73] |

Key to symbols: ●: intoxication; ■: alcohol use, binge drinking, high risk drinking, abusive drinking; ◆: over-serving (to pseudo-drunk customers); ✚: underage drinking; ▲: drinking speed; ↑: indicates an increase associated with the environmental factor; ↓: indicates a decrease associated with the environmental factor. [a]'Average' hygiene in restrooms was associated with reduced service refusal to pseudo-drunk customers, compared with 'good + bad' hygiene. [b]Linked through qualitative/ethnographic research without statistical analysis [48]—moderate lighting observed to be associated with increased risk of alcohol abuse, compared with bright or low lighting; tranquil artwork observed to be associated with controlled social drinking. [c]Probability of over-serving was higher at a communicable noise level, than at high level, low level or no music. [d]Upscale establishment. [e]Shabby decor, no theme, low expenditure on furnishings, low maintenance. [f]Canada: 'anything goes' atmosphere, swearing and overt sexual contact. Sweden: poor overall order at the premises. [g]Against the service of alcohol to drunk customers. Only findings that have been associated with increases or reductions in alcohol measures are shown. Thus findings where associations were absent, mixed or unclear are not included in the table.

three different time-periods (1996, 1999, 2001[39–41]) and findings relating to environmental factors were not consistent between study periods. Table 2 shows environmental factors in bars and nightclubs that have been associated with alcohol-related harm (e.g. aggression, crime, injury and drink driving), and the countries in which these links have been identified. Twenty-three studies in this area were identified, seven of which had been conducted in Europe. Fifteen studies had concluded data collection over a decade prior to the review (1998 or earlier [19–23,26–37,55–57,63–67]). Dates of data collection were not provided for two studies published in 2000 (United Kingdom [68]) and 2007 (United States [58]).

**Physical factors associated with higher levels of alcohol use and harms**

A range of physical factors, including poor ventilation, poor cleanliness, crowding, noise, low lighting, high temperature, shabby decor and low maintenance, have been associated with increased aggression in bars and nightclubs in various countries, either individually or combined when measuring the overall bar environment (Table 2). However, such combined measures can produce contradictory results and have been associated with *lower* levels of crime in UK nightclubs. In Canadian bars, many of these physical factors have also been associated with higher levels of patron intoxication (Table 1). In Europe, loud music volume has been linked to faster drinking speed and alcohol consumption in the Netherlands and France, but to lower levels of over-serving in Sweden (the sale of alcohol to individuals who are already drunk, measured through sales to pseudo-drunk actors; however, relationships between music level and over-serving were not seen in a follow-up study). Studies have also found over-serving to be more likely in *less* crowded venues, while in Sweden, 'average' ratings of cleanliness in washrooms have been related to a higher likelihood of over-serving than either 'good' or 'bad' ratings. In the United Kingdom, low-impact resistant glassware (which breaks more easily) has been associated with increased injuries to bar staff. Here, the low-impact-resistant glassware was marketed as 'toughened' glassware and was being tested for its utility in reducing injuries in bars.

**Table 2** Environmental factors associated with alcohol-related problems.

| Environmental factors | | Countries in which a link has been identified | | | | | |
|---|---|---|---|---|---|---|---|
| | | USA | Australia | Canada | UK | Spain | Bulgaria |
| Physical factors | Poor ventilation/smokiness | ↑● | ↑● | ↑● | | | |
| | Poor cleanliness | ↑● | ↑● | ↑● | ↑●■ | | |
| | Crowded venues/dance floors/bars | ↑● | ↑● | ↑● | | | |
| | Noisy, loud music | ↑● | ↑●ᵃ | ↑● | | ↑● | |
| | Low lighting | | ↑● | | | | |
| | High temperature | ↑● | | | | | |
| | Combined variable including the above | ↑● | | | ↑● ↑↓■ | | |
| | Seating | | ↑●ᵇ | ↑●ᶜ | | | |
| | Low impact-resistance glassware | | | | ↑✚ | | |
| | Unattractive bars (e.g. shabby) | ↑● | | ↑● | | | |
| | Line up | | | ↑● | | | |
| Social factors | Cheap drinks and drinks promotions | ↑● | ↑● | | | ↑● | |
| | Permissive environmentᵈ | ↑●ᵃ | ↑● | ↑● | ↑●■ | ↑● | |
| | Games (e.g. pool, billiards) | ↑● | ↓●ᵉ | ↑● | ↑●■ | ↑● | |
| | Dancing, juke boxes, discos, bands, etc. | ↑● | ↑●▲ | ↑● | | | |
| | Illegal activity (e.g. drugs, prostitution) | ↑● | ↑● | ↑● | ↓●ᶠ | | |
| | Beer, spirits, high volume alcohol sales | | ↑●◆ | | | | |
| | Non-alcoholic drinks on sale | ↓■ | | | | | |
| | Drunk customers | | ↑● | ↑● | ↑●■ | ↑● | |
| | Availability of food | ↓■ | ↓● | ↓● | | | |
| Staff factors | Staff characteristics | ↑●(Most ♂) | ↓●ᵍ | ↓●(All ♀) | | | |
| | Poor staff control/practice | ↑●ʰ | ↑●▲ⁱ | ↑●ʲ,ᵏ | ↑■ˡ | | |
| | Staff intervention | ↑●ᵐ↓■ᵐ | ↑●ⁿ↓●ᵐ | | ●ᵒ | | |
| | Ineffective security staff | ↑● | ↑● | ↑● | | | ↑●ᵃ |
| | Presence of security staff | ↑↓● | ↑● | ↑● | ↑●ᵖ | | |
| | Low staff : patron ratio | | ↑● | | | | |
| References | | [54–62] | [27–37,48,49,63–65] | [19–26] | [66–70] | [74] | [73] |

Key to symbols: ●: aggression, violence, assaults; ■: crime, police complaints/call-outs; ◆: drink driving; ✚: staff injury; ▲: alcohol-related harm (injury, drink driving, crime, violent argument or fight, accident, time off work); ↑: indicates an increase associated with the environmental factor; ↓: indicates a decrease associated with the environmental factor. ᵃLinked through qualitative/ethnographic research without statistical analysis. ᵇLack of seating, low comfort. ᶜSeating in rows. ᵈFor example, low decorum expectancies, rowdiness, swearing, sexual contact, underage patrons. ᵉBoredom associated with aggression; entertainment (e.g. game machines, quizzes, stage shows) reduced boredom. ᶠHigher drug use. ᵍFriendlier security staff. ʰStaff drinking. ⁱContinuing to serve drunk people. ʲAbility to identify and handle problems. ᵏCustomers having 2+ drinks/hanging around at closing time. ˡPresence of underage customers. ᵐID checks. ⁿStaff intervention with drunk customers. ᵒPhysical staff intervention (cf. non-physical) with disorderly customers increased perceptions of violence in a venue. ᵖBased on perceptions of violence in venues with or without security staff. Only findings that have been associated with increases or reductions in alcohol-related harm are shown. Thus findings where associations were absent, mixed or unclear are not included in the table.

## Social factors associated with higher levels of alcohol use and harms

A permissive environment (e.g. 'anything goes' atmosphere, rowdiness, permitting underage patrons; see Tables 1 and 2), drinks promotions and a focus on music and dancing in bars have been associated with higher levels of alcohol use, intoxication and aggression across a range of studies and countries (Tables 1 and 2). In Australia, visiting venues where entertainment focused on music and dancing was linked to increases in a combined 'alcohol-related harm' category covering injury, drink driving, crime, argument or fight, accident or time off work. The type of music being played (e.g. pop, hip-hop, house music) has also been highlighted as a contributor to drinking behaviours and alcohol-related harm in several studies [31,50,70], although this was not explored in detail in this review. In qualitative research in Bulgaria, discounted drinks promotions were linked to underage drinking. Despite the relatively consistent link between permissive environments and aggression across studies and countries, in Sweden venues in which overall order was under control showed higher levels of over-serving.

The presence of games (e.g. pool tables) in drinking venues has been linked to increased aggression in a

range of countries. However, in Australia higher levels of aggression have been related to boredom in bars, with entertainment including game machines, stage shows and quizzes found to relieve boredom. Illegal activities such as drug use, drug dealing and prostitution in drinking venues have been associated with aggression in the United States, Australia and Canada. In UK nightclubs, however, higher aggression has been found in venues with *less* illicit drug use. Sales of beer, spirits and high alcohol content drinks have been associated with increased aggression and drink driving, and sales of non-alcoholic drinks with reduced police complaints. The availability of food has also been linked to lower levels of police complaints, as well as to lower intoxication and aggression. The presence of high proportions of drunk customers in bars and nightclubs has been associated with increased aggression across a range of countries.

### Staffing factors associated with higher levels of alcohol use and harms

No European studies were identified that linked staffing factors to levels and patterns of alcohol use (Table 1). Elsewhere, venues with friendly or all-female staff have been associated with lower levels of patron intoxication, while younger members of staff have been found to be more likely to serve pseudo-drunk customers. A low staff to patron ratio has been associated with increased aggression in Australia. In Canada [24], the staff to patron ratio was not found to be related to incidence of aggression, but a high staff to patron ratio was associated with increased severity of staff aggression (factors that were associated with *severity* of aggression are not included in Table 2).

Poor staff control and practice (e.g. ability to handle problems, continuing to serve drunk customers, drinking while working) has been associated with increased alcohol consumption, aggression, crime and other harms in several non-European studies. Although staff practice has been explored in observational studies in the United Kingdom, no clear relationships between staffing, aggression and crime have been identified [69,70]. However, in one UK study that involved participants viewing scenarios of staff intervention practices in bars, levels of violence in bars were perceived to be higher when staff used physical rather than non-physical intervention with disorderly customers. Staff intervention with drunk customers has been associated with increased aggression in observational research in Australia. However, identity (ID) checking has been associated with reduced aggression. In US studies, ID checking has been linked to both increased aggression and reduced crime. Several studies have found the presence of security staff (e.g. door supervisors, 'bouncers') to increase aggression, although in

the United States findings have been mixed. However, ineffective security staff (e.g. aggressive, permissive) have been linked consistently to aggression in several countries, and observed to be involved in many incidents of violence in Bulgaria. Over-serving has been found to be less likely in venues that have warning signs against the service of alcohol to drunk customers. Over-serving has itself been associated with higher levels of patron alcohol consumption.

## DISCUSSION

This systematic literature review aimed to identify published studies that had explored associations between environmental factors in drinking venues and measures of alcohol use and related harm. A broad inclusion criterion was adopted, which identified 34 studies reported in 53 papers. The studies had used a variety of quantitative and qualitative methods which examined different measures of bar environments and behaviours associated with them. Further, results and conclusions had been drawn from qualitative, bivariate and multivariate analyses, allowing different levels of correction for confounding effects. However, the purpose of the review was not to assess in depth the strength of associations between environmental factors and alcohol-related outcomes, but rather to gain a better understanding of existing literature and study methods to inform new European research (AMPHORA). The review found that the majority of existing literature on drinking environments stemmed from non-European countries. More than two-thirds of studies (*n* = 23; 37 papers) had been conducted in the United States, Australia or Canada. Just 12 had been conducted in European countries, and five of these had been implemented in the United Kingdom. However, the majority of both European and non-European studies identified in the review had incorporated some form of observational research and several had used similar research tools, developed originally in Canada. Thus the review identified a need for additional European research in drinking environments, and provided valuable methodological support for such research.

The studies identified through the review had associated numerous physical, social and staffing factors in drinking environments with higher or lower alcohol consumption, alcohol access and alcohol-related problems (Tables 1 and 2). Factors that appeared particularly important in contributing to alcohol-related problems included a permissive environment, discounted drinks promotions, poor cleanliness, crowding, loud music and poor staff practice. However, study findings were not always consistent. For example, while several studies had found associations between crowding and aggression [27,29,30,32,58,62], one Australian study that had

evaluated an intervention to reduce harm in drinking environments reported that reduced aggression had occurred alongside increased crowding [35,36]. Further, while crowding was linked to increased intoxication in a Canadian study [20], it has also been associated with reduced over-serving to pseudo-drunk customers (United States [44], Sweden [40]). Crowding is thought to contribute to increased aggression by increasing agitators such as discomfort, frustration, bumping and shoving [17]. In Australia, the effects of crowding on aggression were thought to have been offset by improvements in other factors, such as reduced permissiveness, reduced drinks promotions and improved staff practices [35]. In Sweden, researchers suggested that higher over-serving in less crowded venues may have been due to financial reasons, with venues that have fewer patrons being less likely to turn customers away [40].

Of the European studies identified, six had used some form of observational research and two had used the Canadian research tools. These studies, conducted by Forsyth *et al.* in Glasgow, used naturalistic observation first in pubs [69] and then in nightclubs [70]. The pub study findings were largely consistent with international research (Table 2); venues that had more environmental risk factors (as identified in international studies) were found to have higher levels of aggression/police-reported crime. However, findings from the nightclub study showed some differences. For instance, while illicit drug use was associated with increased aggression in international studies, in the UK study higher aggression was associated with *lower* illicit drug use. Some of these effects may be related to the types of drugs being used in different environments. For example, in the United Kingdom ecstasy use is associated closely with nightclubs focused around dance music [75]; the drug is valued by users for its empathetic and socializing functions, and has been associated with lower levels of alcohol use and aggression [70,74]. Conversely, cocaine, with shorter-term stimulant effects, is used in a wider range of licensed premises [75], often in combination with alcohol, and has been associated with increased aggression [74]. Contrary to other research, the Scottish nightclub study also found higher police-reported crime in venues that did *not* have an 'unhealthy ambience' (a combined variable covering physical factors such as poor ventilation, noise and crowding). Here, authors noted that the type of music played in a venue could override consideration for decor, with the overall risk of disorder in nightclubs largely being related to clientele and music style [70].

Despite the smaller literature base in Europe, most European studies had been conducted within the last decade, while the majority of non-European studies had taken place more than a decade prior to the review. This suggests a growing awareness and interest in preventing alcohol-related harm in pubs, bars and nightclubs in Europe, but also a general need for further research in modern drinking venues. Drinking behaviours, nightlife environments and their management change over time, and can vary widely between countries. Further, some European countries (e.g. United Kingdom) have strict regulations governing the operation of bars and nightclubs, whereas elsewhere legislation and its enforcement can be more relaxed (e.g. Slovenia has no formal alcohol licensing system). Such factors can affect both the findings of studies in these countries and their relevance in different nightlife settings. For example, several non-European studies and one early UK study have associated the presence of door supervisors in bars and nightclubs with increased aggression, and stressed the need for such security staff to be trained. Currently in the United Kingdom, however, the employment of door supervisors in late night drinking establishments is typically mandatory, and a national registration scheme requires all individuals working as door supervisors to have undertaken a recognized training course. Consequently, the presence of door supervisors may no longer be considered as a risk factor in late-night drinking environments in the United Kingdom, yet their behaviour and attitudes are likely to remain influential. Also in the United Kingdom, licensing regulation permits local authorities to apply conditions to individual drinking environments based on their experience of crime and disorder. This can include, for example, a requirement to check age identification, use safer (e.g. non-glass) drinking vessels, install closed-circuit television cameras (CCTV) and monitor crowding. Thus, while in some drinking environments these practices may be signs of social responsibility, in others they may be reactive measures introduced to address existing alcohol-related problems.

Findings from this review demonstrate the complexities that can be involved in studying and understanding drinking environments and their impacts on alcohol-related harm across different social, economic, cultural and legislative environments. Developing understanding of the impact of environmental factors in modern bars and nightclubs requires a multi-centre study that incorporates intelligence on both micro-level (i.e. environmental factors in bars and nightclubs) and macro-level (e.g. national legislation) aspects of drinking environments. Europe provides a diverse environment for implementing such a study, with nightlife behaviours, management of drinking environments and environmental factors in bars and nightclubs varying widely [76]. Using the experience gained through research identified in this review, AMPHORA will undertake such a study in the Netherlands, Slovenia, Spain and the United Kingdom. The study will build upon existing knowledge and experience, and utilize internationally developed and tested research

methods and tools, amended as appropriate to meet the needs of modern drinking environments. The study methodology will consist of nationalistic observation using an environmental assessment tool that rates environmental factors in drinking venues and provides a method of systematically recording incidents of alcohol-related harm. Details of these methods, their implementation in various settings and their limitations have been published widely [19–25,32–37,58,69,70]. The AMPHORA study will be the first attempt to conduct such a study in multiple countries, and consequently implementation of the study will involve some additional challenges. For example, the bar selection process must ensure that a valid sample is achieved across research sites, targeting a similar age group and representing both low- and high-risk bars to ensure variance among environmental factors and alcohol-related harms. Particular attention will need to be provided to researcher training in order to address cultural differences in identifying drunkenness and measuring environmental factors, and to encourage consistent recording of data. To increase understanding of levels and patterns of alcohol use and harm in the participating nightlife environments, additional research methods will be used. These will include a short survey and breathalyser test implemented among nightlife users in streets surrounding the research bars [77] and interviews with key stakeholders in the four research sites.

The study findings will seek to inform alcohol policy regarding the development and management of drinking environments in Europe. A well-developed and -managed nightlife can play an important role in the relaxation of individuals, the socialization of communities and the economic regeneration of towns and city centres. However, when poorly managed, pubs, bars and nightclubs can become a focus for drunkenness, public disorder, violence, injury and crime. This study will contribute to the growing body of evidence that relates the structure and management of bars to the health and safety of their staff and patrons and provide intelligence specific to European settings. Such evidence should be utilized to ensure that future nightlife development is not dictated solely by economic drivers, but includes health, crime and social inclusion as critical criteria.

### Declarations of interest

None declared.

### Acknowledgements

### References

1. Commission of the European Communities. *An EU Strategy to Support Member States in Reducing Alcohol Related Harm*. 2006. Available at: http://ec.europa.eu/health/ph_determinants/life_style/alcohol/documents/alcohol_com_625_eh.pdf Archived by WebCite® at http://www.webcitation.org/5v154bEKb_16 (accessed 12 July 2009).

2. Mäkelä P., Gmel G., Grittner U., Kuendig H., Kuntsche S., Bloomfield K. *et al*. Drinking patterns and their gender differences in Europe. *Alcohol Alcohol* 2006; **41**: i8–18.

3. Andersson B., Hibell B., Beck F., Choquet M., Kokkevi A., Fotiou A. *et al. Alcohol and Drug Use Among European 17–18 Year Old Students: Data from the ESPAD Project*. Stockholm: The Swedish Council for Information on Alcohol and Other Drugs; 2007.

4. Bellis M. A., Hughes K., Calafat A., Juan M., Ramon A., Rodriguez J. A. *et al*. Sexual uses of alcohol and drugs and the associated health risks: a cross sectional study of young

people in nine European cities. *BMC Public Health* 2008; **8**: 155.

5. Anderson P., Baumberg B. *Alcohol in Europe: A Public Health Perspective*. London: Institute of Alcohol Studies; 2006.

6. Hibell B., Guttormsson U., Ahlström S., Balakireva O., Bjarnason T., Kokkevi A. *et al. The 2007 ESPAD Report: Substance Use Among Students in 35 European Countries*. Stockholm: The Swedish Council for Information on Alcohol and Other Drugs; 2009.

7. Järvinen M., Room R., editors. *Youth Drinking Cultures: European Experiences*. Aldershot: Ashgate Publishing Limited; 2007.

8. Leifman H. A comparative analysis of drinking patterns in 6 EU countries in the year 2000. *Contemp Drug Probl* 2002; **29**: 501–48.

9. Calafat A., Blay N., Juan M., Adrover D., Bellis M. A., Hughes K. *et al*. Traffic risk behaviors at nightlife: drinking, taking drugs, driving, and use of public transport by young people. *Traffic Inj Prev* 2009; **10**: 162–69.

10. Schnitzer S., Bellis M. A., Anderson Z., Hughes K., Calafat A., Juan M. *et al*. Nightlife violence—a gender specific view on risk factors for violence in nightlife settings; a cross sectional study in nine European countries. *J Interpers Violence* 2010; **25**: 1094–112. doi:10.1177/0886260509340549.

11. Kershaw C., Nicholas S., Walker A. *Crime in England and Wales 2007/08: Findings from the British Crime Survey*. London: Home Office; 2008.

12. Hughes K., Anderson Z. A., Morleo M., Bellis M. A. Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes. *Addiction* 2008; **103**: 60–5.

13. Steen K., Hunskaar S. Violence in an urban community from the perspective of an accident and emergency department: a two-year prospective study. *Med Sci Monit* 2004; **10**: CR75–9.

14. Ricci G., Majori S., Mantovani W., Zappaterra A., Rocca G., Buonocore F. Prevalence of alcohol and drugs in urine of patients involved in road accidents. *J Prev Med Hyg* 2008; **49**: 89–95.

15. Briscoe S., Donnelly N. Problematic licensed premises for assault in inner Sydney, Newcastle and Wollongong. *Aust NZ J Criminol* 2003; **36**: 18–33.

16. Newton A., Hirschfield A. Measuring violence in and around licensed premises: the need for a better evidence base. *Crime Prev Comm Saf* 2009; **11**: 153–70.

17. Graham K., Homel R. *Raising the Bar: Preventing Aggression in and Around Bars, Pubs and Clubs*. Cullompton: Willan Publishing; 2008.

18. Green J., Plant M. A. Bad bars: a review of risk factors. *J Subst Abuse* 2007; **12**: 157–89.

19. Graham K., La Rocque L., Yetman R., Ross T. J., Guistra E. Aggression and barroom environments. *J Stud Alcohol* 1980; **41**: 277–92.

20. Graham K. Determinants of heavy drinking and drinking problems: the contribution of the bar environment. In: Single E., Storm T., editors. *Public Drinking and Public Policy*. Toronto: Addiction Research Foundation; 1985, p. 71–84.

21. Wells S., Graham K., West P. The good, the bad, and the ugly: responses by security staff to aggressive incidents in public drinking settings. *J Drug Issues* 1998; **28**: 817–36.

22. Graham K., West P., Wells S. Evaluating theories of alcohol-related aggression using observations of young adults in bars. *Addiction* 2000; **95**: 847–63.

23. Graham K., Wells S. Aggression among young adults in the social context of the bar. *Addict Res Theory* 2001; **9**: 193–219.

24. Graham K., Bernards S., Osgood D. W., Wells S. Bad nights or bad bars? Multi-level analysis of environmental predictors of aggression in late-night large-capacity bars and clubs. *Addiction* 2006; **101**: 1569–80.

25. Graham K., Osgood D. W., Wells S., Stockwell T. To what extent is intoxication associated with aggression in bars? A multilevel analysis. *J Stud Alcohol* 2006; **67**: 382–90.

26. Graham K., Wells S. 'Somebody's gonna get their head kicked in tonight!': aggression among young males in bars—a question of values? *Br J Criminol* 2003; **43**: 546–66.

27. Homel R., Tomsen S. Pubs and violence: violence, public drinking and public policy. *Curr Aff Bull* 1991; **68**: 20–7.

28. Tomsen S., Homel R., Thommeny J. The causes of public violence: situational 'versus' other factors in drinking related assaults. In: Chappell D., Grabosky P., Strang H., editors. *Australian Violence: Contemporary Perspectives*. Sydney: Australian Institute of Criminology; 1991, p. 176–93.

29. Homel R., Tomsen S., Thommeny J. Public drinking and violence: not just an alcohol problem. *J Drug Issues* 1992; **22**: 679–97.

30. Macintyre S., Homel R. Danger on the dancefloor: a study of interior design, crowding and aggression in nightclubs. In: Homel R., editor. *Policing for Prevention: Reducing Crime, Public Intoxication and Injury*, vol. 7. Monsey: Criminal Justice Press; 1997, p. 91–113.

31. Homel R., Hauritz M., Wortley R., McIlwain G., Carvolth R. Preventing alcohol-related crime through community action: the surfers paradise safety action project. In: Homel R., editor. *Policing for Prevention: Reducing Crime, Public Intoxication and Injury*. Monsey: Criminal Justice Press; 1997, p. 35–90.

32. Homel R., Clark J. *The Prediction and Prevention of Violence in Pubs and Clubs. Crime Prevention Studies*, vol. 3. New York: Criminal Justice Press; 1994.

33. Homel R., Hauritz M., McIlwain G., Wortley R., Carvolth R. Preventing drunkenness and violence around nightclubs in a tourist resort. In: Clark R. V. G., editor. *Situational Crime Prevention: Successful Case Studies*. Guilderland: Harrow and Heston; 1997, p. 263–82.

34. Hauritz M., Homel R., McIlwain G., Burrows T., Townsley M. Reducing violence in licensed venues through community safety action projects: the Queensland experience. *Contemp Drug Probl* 1998; **25**: 511–51.

35. Hauritz M., Homel R., Mcllwain G., Burrows T., Townsley M. *Reducing Violence in Licensed Venues: Community Safety Action Projects*. Canberra: Australian Institute of Criminology; 1998.

36. Hauritz M., Homel R., Townsley M., Burrows T., McIlwain G. *An Evaluation of the Local Government Safety Action Projects in Cairns, Townsville and Mackay*. Brisbane: Griffith University; 1998.

37. Homel R., Carvolth R., Hauritz M., McIlwain G., Teague R. Making licensed venues safer for patrons: what environmental factors should be the focus of interventions? *Drug Alcohol Rev* 2004; **23**: 19–29.

38. Wallin E., Norström T., Andréasson S. Alcohol prevention targeting licensed premises: a study of effects on violence. *J Stud Alcohol* 2003; **64**: 270–77.

39. Andreasson S., Lindewald B., Rehnman C. Over-serving patrons in licensed premises in Stockholm. *Addiction* 2000; **95**: 359–63.

40. Wallin E., Gripenberg J., Andreasson S. Too drunk for a beer? A study of overserving in Stockholm. *Addiction* 2002; **97**: 901–07.

41. Wallin E., Gripenberg J., Andreasson S. Overserving at licensed premises in Stockholm: effects of a community action program. *J Stud Alcohol* 2005; **66**: 806–14.

42. Hughes K., Jones L., Bellis M. A. *Reducing Harm in Drinking Environments*. Liverpool: Centre for Public Health, Liverpool John Moores University; 2009.

43. Calafat A., Juan M. Health and safety problems in recreational nightlife in the island of Mallorca. *Int J Drug Policy* 2004; **15**: 157–62.

44. Lenk K. M., Toomey T. L., Erickson D. J. Propensity of alcohol establishments to sell to obviously intoxicated patrons. *Alcohol Clin Exp Res* 2006; **30**: 1194–99.

45. Van de Goor L. A. M. *Situational Aspects of Adolescent Drinking Behaviors*. Maastricht: Datawyse; 1990.

46. Knibbe R. A., Van de Goor L., Drop M. J. Contextual influences on young people's drinking rates in public drinking places: an observational study. *Addict Res* 1993; **1**: 269–78.

47. Van de Goor L. A., Knibbe R. A., Drop M. J. Adolescent drinking behavior: an observational study of the influence of situational factors on adolescent drinking rates. *J Stud Alcohol* 1990; **51**: 548–55.

48. Chikritzhs T., Stockwell T. The impact of later trading hours for hotels on levels of impaired driver road crashes and driver breath alcohol levels. *Addiction* 2006; **101**: 1254–64.

49. Chikritzhs T., Stockwell T. The impact of later trading hours for Australian public houses (hotels) on levels of violence. *J Stud Alcohol* 2002; **63**: 591–99.

50. Schaefer J. M. The physical setting: behaviour and policy. In: Single E., Storm T., editors. *Public Drinking and Public Policy*. Toronto: Addiction Research Foundation; 1984, p. 71–84.

51. Babor T. F., Mendelson J. H., Uhly B., Souza E. Drinking patterns in experimental and barroom settings. *J Stud Alcohol* 1980; **41**: 635–51.

52. Kuo M., Wechsler H., Greenber P., Lee H. The marketing of alcohol to college students: the role of low prices and special promotions. *Am J Prev Med* 2003; **25**: 204–11.

53. Thombs D. L., Dodd V., Porkorny S. B., Omli M. R., O'Mara R., Webb M. C. *et al.* Drink specials and the intoxication levels of patrons exiting college bars. *Am J Health Behav* 2008; **32**: 411–19.

54. Toomey T. L., Wagenaar A. C., Erickson D. J., Fletcher L. A., Patrek W., Lenk K. M. Illegal alcohol sales to obviously intoxicated patrons at licensed establishments. *Alcohol Clin Exp Res* 2004; **28**: 769–74.

55. Buddie A. M., Parks K. A. The role of the bar context and social behaviors on women's risk for aggression. *J Interpers Violence* 2003; **18**: 1378–93.

56. Fox J. G., Sobol J. J. Drinking patterns, social interaction, and barroom behavior: a routine activities approach. *Deviant Behav* 2000; **21**: 429–50.

57. Johannessen K., Glider P., Collins C., Hueston H., Dejong W. Preventing alcohol-related problems at the University of Arizona's homecoming: an environmental management case study. *Am J Drug Alcohol Abuse* 2001; **27**: 587–97.

58. Roberts J. C. Barroom aggression in Hoboken, New Jersey: don't blame the bouncers! *J Drug Educ* 2007; **37**: 429–45.

59. Collins R. L., Quigley B., Leonard K. E. Women's physical aggression in bars: an event-based examination of precipitants and predictors of severity. *Aggress Behav* 2007; **33**: 304–13.

60. Leonard K. E., Collins R., Quigley B. M. Alcohol consumption and the occurrence and severity of aggression: an event-based analysis of male to male barroom violence. *Aggress Behav* 2003; **29**: 346–65.

61. Leonard K. E., Quigley B. M., Collins R. L. Drinking, personality, and bar environmental characteristics as predictors of involvement in barroom aggression. *Addict Behav* 2003; **28**: 1681–700.

62. Quigley B. M., Leonard K. E., Collins R. L. Characteristics of violent bars and bar patrons. *J Stud Alcohol* 2003; **64**: 765–72.

63. Stockwell T., Lang E., Rydon P. High risk drinking settings: the association of serving and promotional practices with harmful drinking. *Addiction* 1993; **88**: 1519–26.

64. Lang E., Stockwell T., Rydon P., Lockwood A. Drinking settings and problems of intoxication. *Addict Res* 1995; **3**: 141–49.

65. Gruenewald P. J., Stockwell T., Beel A., Dyskin E. V. Beverage sales and drinking and driving: the role of on-premise drinking places. *J Stud Alcohol* 1999; **60**: 47–53.

66. Leather P., Lawrence C. Perceiving pub violence: the symbolic influence of social and environmental factors. *Br J Soc Psychol* 1995; **34**: 395–407.

67. Marsh P., Kibby K. F. *Drinking and Public Disorder*. London: Portland Group; 1992.

68. Warburton A. L., Shepherd J. P. Effectiveness of toughened glassware in terms of reducing injury in bars: a randomised controlled trial. *Inj Prev* 2000; **6**: 36–40.

69. Forsyth A. J. M., Cloonan M., Barr J. *Factors Associated with Alcohol-Related Problems within Licensed Premises*. Glasgow: Greater Glasgow NHS Board; 2005.

70. Forsyth A. J. M. *Assessing the Relationships Between Late Night Drinks Marketing and Alcohol-Related Disorder in Public Space*. Glasgow: Glasgow Caledonian University; 2006.

71. Gueguen N., Le Guellec H., Jacob C. Sound level of background music and alcohol consumption: an empirical evaluation. *Percept Mot Skills* 2004; **99**: 34–8.

72. Gueguen N., Jacob C., Le Guellec H., Morineau T., Lourel M. Sound level of environmental music and drinking behaviour: a field experiment with beer drinkers. *Alcohol Clin Exp Res* 2008; **32**: 1795–98.

73. Tutenges S. Safety problems among heavy-drinking youth at a Bulgarian nightlife resort. *Int J Drug Policy* 2009; **20**: 444–46.

74. Hughes K., Bellis M. A., Calafat A., Juan M., Schnitzer S., Anderson Z. Predictors of violence in young tourists: a comparative study of British, German and Spanish holidaymakers. *Eur J Public Health* 2008; **18**: 569–74.

75. Measham F. Play space: historical and socio-cultural reflections on drugs, licensed leisure locations, commercialisation and control. *Int J Drug Policy* 2004; **15**: 337–45.

76. Institut de Recherché European sur les Facteurs de Risque chez l'Enfant et l'Adolescent (IREFREA). *Recreational Culture as a Tool to Prevent Risk Behaviours: Ethnography Reports*. Available at: http://www.irefrea.org/Index.asp?idcontenido=3797 Archived by WebCite® at http://www.webcitation.org/5v14pqpYL (accessed 24 July 2009).

77. Hughes K., Quigg Z., Bellis M. A., Morleo M., Jarman I., Lisboa P. *Blood Alcohol Levels and Drunkenness Amongst People Visiting Nightlife in the North West*. Liverpool: Centre for Public Health, Liverpool John Moores University; 2009.

SUBSTANCE ABUSE TREATMENT,
PREVENTION, AND POLICY

**RESEARCH**                                                                                          **Open Access**

# Cross-sectional measures and modelled estimates of blood alcohol levels in UK nightlife and their relationships with drinking behaviours and observed signs of inebriation

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## Abstract

**Background:** Management of nightlife in UK cities focuses on creating safe places for individuals to drink. Little is known about intoxication levels as measuring total alcohol consumption on nights out is complicated by early evening interviews missing subsequent consumption and later interviews risking individuals being too drunk to recall consumption or participate at all. Here we assess mixed survey and modelling techniques as a methodological approach to examining these issues.

**Methods:** Interviews with a cross sectional sample of nightlife patrons (n = 214) recruited at different locations in three cities established alcohol consumption patterns up to the point of interview, self-assessed drunkenness and intended drinking patterns throughout the remaining night out. Researchers observed individuals' behaviours to independently assess drunkenness. Breath alcohol tests and general linear modelling were used to model blood alcohol levels at participants' expected time of leaving nightlife settings.

**Results:** At interview 49.53% of individuals regarded themselves as drunk and 79.43% intended to consume more alcohol before returning home, with around one in ten individuals (15.38% males; 4.35% females) intending to consume >40 units (equal to 400 mls of pure alcohol). Self-assessed drunkenness, researcher observed measures of sobriety and blood alcohol levels all correlated well. Modelled estimates for blood alcohol at time of going home suggested that 71.68% of males would be over 0.15%BAC (gms alcohol/100 mls blood). Higher blood alcohol levels were related to drinking later into the night.

**Conclusions:** UK nightlife has used substantive health and judicial resources with the aim of creating safer and later drinking environments. Survey and modelling techniques together can help characterise the condition of drinkers when using and leaving these settings. Here such methods identified patrons as routinely getting drunk, with risks of drunkenness increasing over later nights. Without preventing drunkenness and sales to intoxicated individuals, extended drinking hours can simply act as havens for drunks. A public health approach to nightlife is needed to better understand and take into account the chronic effects of drunkenness, the damages arising after drunk individuals leave city centres and the costs of people avoiding drunken city centres at night.

## Background

In many countries, developing a safer nightlife has become synonymous with reducing violence, accidents and other immediate threats to health and well-being in town and city centres [1,2]. Safety initiatives often include

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elements such as high visibility policing, security staff located at late night transport points, improved street lighting, closed circuit television cameras and strict enforcement activity targeted at bars associated with alcohol-related crime [3,4]. Such measures aim to discourage the illegal and anti-social behaviours frequently associated with heavy drinking, but can allow such drinking to continue unabated. Thus, individuals who have

drank heavily or who consider themselves drunk can often continue to participate in nightlife so long as they do not create a major disturbance, or until their increasing intoxication puts their own safety in obvious and immediate danger (e.g. they cannot walk) [5,6]. In contrast, less investment has focused on initiatives to prevent the underlying cause of many nightlife problems, i.e. drinking to intoxication. Sales regulations can prevent individuals buying alcohol when they are overtly intoxicated but these can be ignored by vendors due to factors including commercial pressure to sell alcohol, low awareness or personal responsibility by bar staff, and difficulties identifying and refusing service to drunk customers [7-9]. Campaigns targeting heavy drinkers can warn of the acute harms of drunkenness (e.g. sexual assault, injury) and provide harm reduction advice (e.g. encouraging consumption of non-alcoholic drinks alongside alcoholic ones), but typically such advice does not set or suggest any upper alcohol limits for a drinking session [10].

Managing rather than preventing drunkenness in nightlife places considerable pressures on public services through high cost policing [11,12] and treatment for those intoxicated or injured [13]. Moreover, the success of such management strategies is often measured by levels of violence and injury recorded in public nightlife settings [3,14,15]. Frequently, it ignores harms that may occur when people return to residential areas (e.g. subsequent public disturbances) or within individuals' homes (e.g. alcohol-related domestic violence, child abuse and fires [16-18]). Furthermore, dangers to drinkers' proximal health (e.g. alcohol-related asphyxia at home), employment (e.g. next day absenteeism and workplace injuries) and longer term well-being (e.g. alcohol-related liver disease) are also excluded from assessments of nightlife safety.

The UK has a well established culture of heavy drinking in nightlife settings [19]. Despite this, there is relatively little information available on either self-assessed, independently observed (i.e. observed sobriety) or biologically measured (i.e. blood alcohol level) drunkenness in nightlife environments [20,21]. The paucity of such information leads to no clear understanding of what constitutes drunkenness, the health dangers that getting routinely drunk represent, or how regulations to reduce drunkenness in night time environments (e.g. no sales to intoxicated individuals) might be implemented. While the UK has laws restricting alcohol sales to drunk individuals, these are rarely enforced [22]. Further, despite extending licensing hours to avoid binge drinking sessions just prior to bars closing, there is a lack of work examining changes in drunkenness (rather than crime or injury) in nightlife settings resulting from later opening hours [23]. Here, we have undertaken a study across three UK cities to explore self-assessed, independently observed and biologically measured drunkenness in nightlife patrons during their nights out. While other studies have used cross-sectional surveys combined with breath alcohol tests to explore relationships between blood alcohol levels, sobriety and alcohol consumption [20,21,24,25], interpreting such methods is complicated by early evening interviews missing subsequent consumption and later interviews risking individuals being too drunk to recall consumption or participate at all. Here we use direct empirical measures combined with modelling techniques to calculate the state of inebriation in which individuals are likely to return home and how this relates to drinking behaviours, demographics and the time at which people leave city centres.

## Methods
Three major city centres in the North West of England, each with a well developed nightlife, were utilised as study sites (Liverpool, Manchester and Chester). Teams of two researchers accompanied by a supervisor worked on Friday and Saturday nights in March and April 2009 between 8pm and 2am. Recruitment of participants used a structured approach with two teams working in parallel and using a series of different locations within each city for periods of one to two hours at a time (target sample n = 200). However despite sampling occurring across each city's nightlife areas, participants were not expected to be a representative sample but rather a prospective sample indicative of the range of individuals engaged in recreational drinking in nightlife settings. Participants completed a short anonymous questionnaire and undertook a breath alcohol test (BrAT). The questionnaire examined: quantities of alcohol consumed to the point of survey (by type of beverage); whether individuals had preloaded before going out that night (e.g. drank alcohol at their own or a friend's home); age; height; and whether respondents felt drunk or believed they were above the legal UK limit for drink-driving (80 milligrams of alcohol per 100 millilitres of blood; 0.08%BAC; blood alcohol concentration). The survey also explored how many hours had passed since the beginning of their drinking session, the time since they last ate a meal, the time at which they would typically expect to leave the nightlife setting and how much more alcohol they intended to consume before leaving. All questionnaires were completed by researchers on behalf of participants through an interview process.

### Participant recruitment
All individuals out for recreational purposes and drinking alcohol were eligible for inclusion in the survey. Of those individuals approached by researchers, all identified that they fulfilled these criteria and therefore none were

rejected at that stage. However for the purposes of safety, and to accommodate ethics relating to informed consent, individuals showing severe signs of inebriation were excluded. To assess levels of drunkenness, all potential participants were visually assessed by researchers through a tool incorporating measures used by police and in previous studies [20]. Prior to being approached, individuals were monitored for steadiness on their feet (staggering, swaying) and loud or aggressive talking (Likert scale; 1 = none to 5 = strong signs). Individuals scoring four or more in any category were not approached. For those approached and agreeing to participate, further measures (difficulty focusing, slurring words, incoherent speech, glazed eyes and close talking distance) were assessed on the same scale throughout the interview process. Calculating the total number of individuals excluded due to severe inebriation was not possible as no record was kept of those individuals who were so inebriated (e.g. could not walk) that they would clearly fail on any sobriety assessment. Researchers also made visual assessments of participants' build on a scale of 1 to 5 (1 = very slight, 5 = heavy build). Researchers were trained in the application of these assessments in order to improve grading consistency. A total of 271 eligible individuals were approached for the study, of which 57 (21.03%) declined to take part before the purpose of the research was explained to them. None subsequently refused once the study had been explained. Overall, a final sample of 214 took part in the survey (n = 111, 65, 38 in Liverpool, Manchester and Chester respectively).

## Measuring blood alcohol concentrations

Participants were recruited and interviewed in streets outside nightlife areas and around transport points (e.g. bus and taxi ranks). A BrAT was conducted on all participants using the Lion Alcometer® 500 Breath Alcohol Kit, a variation of the model used by UK police [26] and other law enforcement agencies. To comply with BrAT requirements, the study process was designed to ensure sufficient time had passed (20 minutes) for any alcohol in the participants' mouths to have absorbed prior to breath testing, and participants were requested not to smoke

during interview [27]. Each participant was provided with their own mouthpiece, which was discarded safely once used. The analytical response time of the test is typically within 30 seconds and BrAT test scores were immediately provided to participants, as well as being recorded by researchers. For the purposes of analysis BrAT results were converted into %BAC (according to established UK ratios) as this is a more commonly used and legally referenced measure [28]. Reported alcohol products consumed were converted into standard UK units (1 unit = 8 grams or 10 ml of pure alcohol) using published figures for alcohol contents (e.g. single shot of spirits = 1 unit; bottle of lager = 1.5 units; standard glass of wine = 2 units [29]).

## Modelling final blood alcohol

Most individuals surveyed (79.43%) had not completed their planned alcohol consumption for that night (and if they had may have been too intoxicated to fulfil inclusion criteria). Significant relationships between %BAC and all variables measured at the time of interview, e.g. demographics, body size, units consumed and drinking rate, were estimated with General Linear Models (GLM) [30]. All continuous variables were log transformed and in the final model no demographic or body size variables were significant (Table 1). Individuals had already provided details of how much longer they would expect to remain out drinking and their estimated additional alcohol consumption over the remainder of their night out. By adding these to measures of hours drinking, units consumed and hours since having eaten a meal at time of interview, new estimated final total units consumed, total hours drinking, average drinking rate and hours since having eaten a meal for their entire session (i.e. up to point of expected home time) were calculated. For each individual these data were then used within the model to estimate final %BAC at their expected time of departing the nightlife setting.

## Statistical analyses

All data were entered into, and analysed using, SPSS (V15). Statistical analyses utilised chi-square, ANOVA

**Table 1: General linear model for prediction of blood alcohol levels**

| Model items | Estimate | SE | F | P |
| --- | --- | --- | --- | --- |
| Intercept | -1.8844 | 0.07 | 631.7 | <0.001 |
| Log units per hour | 0.6369 | 0.09 | 53.47 | <0.001 |
| Log hours drinking | 0.7333 | 0.07 | 112.8 | <0.001 |
| Log hours since ate | 0.1595 | 0.05 | 9.087 | <0.005 |

Age, sex, height, build, city and preloading were also included in the stepwise model but only hours drinking, drinking rate and hours since eating a meal were significantly related to %BAC at interview. The final model accounted for 40.02% of the variance. Degrees of freedom: Model = 3; Intercept = 1; Log units per hour = 1, Log hours drinking = 1, Log hours since ate = 1; Error = 207. SE = standard error

and GLM. Research was reviewed and passed by Liverpool John Moores University Research Ethics Committee.

## Results

Samples did not differ between study sites in mean number of hours drinking, total units consumed, units consumed per hour (units/hr) or mean %BAC at time of interview (Additional file 1). Mean values for males were higher than females for each measure (Additional file 1). Those who reported preloading before arriving in city centres had consumed more units of alcohol although differences in %BAC (between those who did and did not preload) just failed to reach significance (Additional file 1). However, %BAC, hours drinking and total units consumed were positively associated with self-reported feeling drunk, while %BAC and units consumed were also associated with having recently eaten a meal (specifically in the last four hours; Additional file 1). Build and age were not related to any measures of drinking behaviour or %BAC. While height was related to number of units consumed, units/hr and %BAC, this was primarily due to its relationship with sex. Thus, when analysed separately by gender, no measures of drinking behaviours were significantly related to height, and %BAC only differed by height category in females (ANOVA, $F_{3,90} = 2.857$, $P < 0.05$). All individuals, regardless of %BAC, were informed about their BrAT results and whether the reading was above or below UK legal driving limits. Only 3.55% stated that they would drink less as a result of knowing their %BAC (mean %BAC = 0.15) with 24.87% saying they would drink more (mean %BAC = 0.12) and 71.57% saying it would have no effect (mean %BAC = 0.11; %BACs were not significantly different between groups, ANOVA, $F_{2,194} = 0.922$, $P = 0.399$).

Additional file 2(a-d) compares the distribution of units consumed, hours drinking and units/hr as well as %BAC at time of interview (actual) and at planned time of leaving city centres (home time) for males and females separately. For both sexes there was no significant difference between drinking rate during the period up to being interviewed and the rate estimated for the whole evening up until home time (Additional file 2c). However, in both males and females estimated %BAC was higher at home time compared with measured %BAC at time of interview (Additional file 2d). Across all measures of drinking behaviour and %BAC, males' home time estimates were significantly different to females', with higher %BACs, units drank, hours drinking and units/hr in males (Additional file 2a-d). Mean predicted %BAC for males at home time was 0.19 (95%CIs, 0.17-0.20) and for females 0.13 (95%CIs, 0.11-0.14) and total units consumed were 27.43 (95%CIs, 24.68-30.18) and 16.17 (95%CIs, 13.84-18.49) respectively. For those who preloaded (vs those who did not preload) the estimated total time drinking (mean

hours, 9.40 vs 7.77, ANOVA, $F_{1,208} = 8.47$, $P < 0.005$), total units (mean units, 25.97 vs 18.63, ANOVA, $F_{1,207} = 14.77$, $P < 0.001$), units/hr over the whole drinking session (mean units/hr, 2.95 vs 2.38, ANOVA, $F_{1,203} = 6.91$, $P < 0.01$) and expected %BAC at home time (mean %BAC, 0.18 vs 0.14, ANOVA, $F_{1,201} = 16.32$, $P < 0.001$) were all significantly higher.

Levels of %BAC at interview were strongly related to observational sobriety measures. Proportions of individuals showing signs of each drunkenness measure (score ≥ 2) increased significantly with measured %BAC (Additional file 3). Thus, only 15% of those with a %BAC of ≤ 0.05 were showing signs of unsteadiness on their feet compared with all of those with a %BAC >0.25. Similarly figures for slurring speech during interviews rose from 22.50% to 100% respectively. Furthermore, self-assessed drunkenness was strongly related to %BAC. Half (49.53%) of participants reported feeling drunk at interview, increasing from 10.00% of those with %BAC ≤ 0.05 to 83.33% of those with %BAC >0.25 (Additional file 3). Self-assessed drunkenness also correlated well with researcher-observed measures with, for instance, 71.70% of those assessed as unsteady on their feet self-reported as drunk (Additional file 3).

Finally, the relationship between participants' expected home time and predicted %BAC at that time was examined. There was a strong positive correlation between %BAC and time leaving nightlife, increasing from a mean of 0.09%BAC in those intending to leave before midnight to 0.21%BAC in those intending to leave at or after 4am (Figure 1).

## Discussion

In order to examine relationships between alcohol consumption and levels of inebriation in patrons of UK nightlife, a cross-sectional survey of drinkers' %BAC and drinking behaviours was undertaken in three UK cities. Individuals who were already severely inebriated [21,31] were excluded. This may have resulted in conservative estimates of drunkenness and alcohol consumption. However, our methods included many individuals who assessed themselves as being drunk and who would become drunk later in the night. Moreover, this did not affect within-individual comparisons of drinking behaviours with observed, self-assessed and biologically measured (BrAT) drunkenness. Consequently, GLMs were employed to calculate the %BAC of participants at their point of departure from nightlife centres, frequently after they would have drunk substantially more alcohol (Additional file 2). The explanatory variables in this observational study were restricted to demographic and self-reported behavioural information, from which GLMs explained 40% of the variation in %BAC. However, the
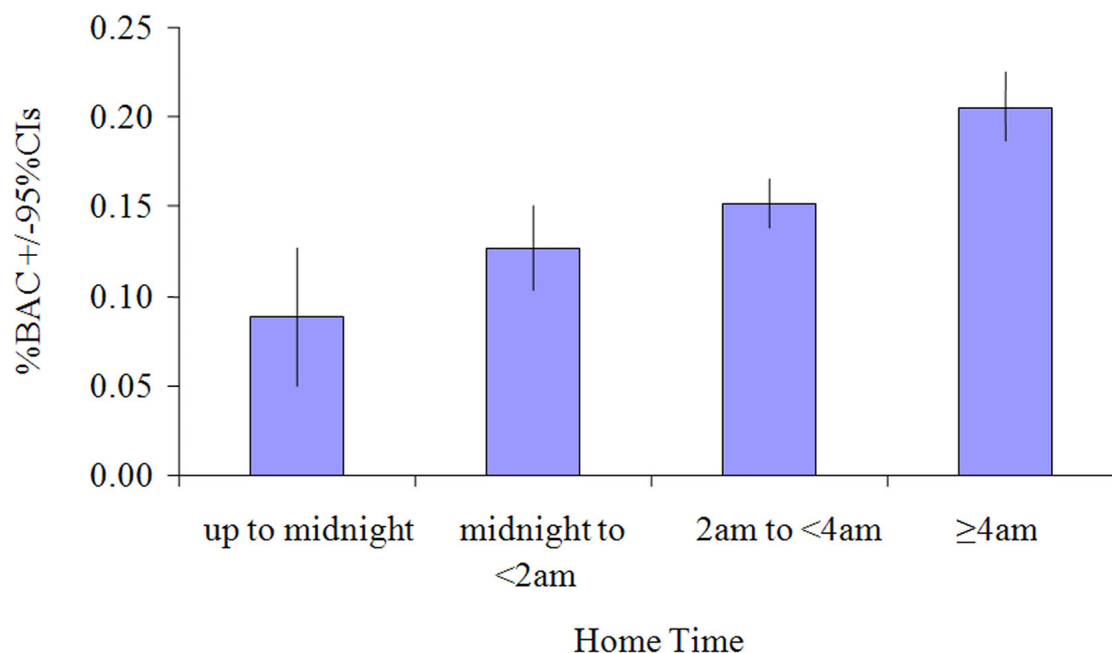
%BAC +/-95% CIs = blood alcohol concentration, gms alcohol/100mls blood +/- 95% Confidence Intervals.

**Figure 1 Relationship between expected home time and modelled blood alcohol concentration at home time**. %BAC = blood alcohol concentration, gms alcohol/100 mls blood.

impact of the unexplained variance is likely to be mitigated by comparisons and conclusions being based on mean %BACs rather than calculations for any individual. Further, this methodology: achieved good compliance; is likely to have allowed better recall than interviewing more inebriated people at the end of the night [31]; and resulted in reported consumption consistent with other studies of similar populations [5]. Unlike in other studies, our final model did not improve from the inclusion of sex or body size and even forced inclusion of these measures did not improve the variance explained [32-34]. However, the model was developed using data from the same individuals to which it was subsequently applied and was bespoke to real drinking environments rather than based on laboratory like conditions. Thus, while other generic models for calculating %BAC from consumption are available [33], when used in comparable drinking environments they have resulted in poorer predictions of %BAC (e.g. only around 20% of variance explained [35]). Importantly, when using the model predictions of %BACs at home time, the vast majority of home time (estimated) values for hours drinking (97.1%), drinking rates (100%), hours since at a meal (97.1%) and %BAC (99.5%) were within the observed range at interview. Therefore the model was not extrapolating substantially beyond its

training values. Our %BAC measurements also relied on the appropriate use of the BrATs. In particular, a period of 20 minutes is recommended between last drink and breath analysis [27]. Consequently, our study was designed to maximise time between drinking and BrAT, with participants approached outside of drinking establishments, and then introduced to the study and interviewed before %BAC was measured. Finally, there was no control of whether, post-interview, individuals would consume another meal before home time. However, individuals typically seek takeaway meals or other food at the end of the evening and food consumption appears to have made only a relatively small difference to %BAC (table 1) compared with other factors in our model.

Even at interview and with study criteria excluding those showing strong signs of drunkenness, 49.53% of respondents assessed themselves as being drunk. At least in our sample, drunkenness was a typical part of nights out rather than, as sometimes suggested, limited to a few individuals [36]. At home time, modelling suggests %BACs will be considerably higher (Additional file 2d) and drunkenness will be the rule rather than the exception. Given the patterns of alcohol consumption identified this is not surprising. By home time, 10.53% of individuals (15.38% males; 4.35% females; Additional file

2a) intended to have drunk more than 40 units. In fact, even at interview 20.00% of males and 21.28% of females had drank more than the weekly alcohol limits (21 units, males; 14 units, female [37]) recommended by the UK government prior to the introduction of daily recommended limits, and at home time these figures were estimated to rise to 60.68% and 44.57% respectively. Excess alcohol was often consumed over long drinking periods. For males 21.18% of individuals were expecting to have been drinking for more than 12 hours before returning home. Time drinking, total units consumed and, to a lesser extent, units consumed per hour were positively related to preloading and resulted in preloaders having a significantly higher predicted %BAC at home time.

As well as effects relating to preloading, our results are consistent with extensions to licensing hours contributing to a higher prevalence of drunkenness (Figure 1). In 2005, licensing regulations in England and Wales changed to allow alcohol to be sold 24 hours a day [38]. Although most on- and off-licence establishments have not adopted 24 hour opening, many have extended their opening hours [39]. Here, those individuals intending to utilise the later hours were also most likely to have the highest %BACs (Figure 1). While our sample could not be considered representative of all UK nightlife users, results would at least support the hypothesis that later opening hours can increase inebriation and our methodology provides a mechanism for subsequent tests of this relationship. Already, police and health resources are stretched into early morning hours to allow drunkenness to progress in relative safety and to respond when incidents occur [12,40]. Importantly, high visibility policing and easily accessible emergency health care may actually encourage individuals to get drunk in the knowledge that the immediate risks associated with drunkenness are substantially reduced [41,42].

As technologies such as those employed in this study to measure %BAC (BrAT) become more accessible and affordable they may create an additional pressure to consume more alcohol. Only 3.55% of individuals said they would reduce their drinking once informed of their %BAC while nearly one in four individuals thought they would drink more. While this phenomenon needs more study, individuals in the UK can feel that an important feature of a night out drinking is to become drunk. A measured %BAC close to, or even under, the legal driving limit may appear to some drinkers as inconsistent with such an objective and consequently provide an incentive to drink more. Commercial use of BrATs to encourage individuals to drink more has already been attempted in some bars in the UK [43] and similar problems have been seen elsewhere [3]. Such tests also pose a danger for drink-driving. In our sample, of those below the legal maximum %BAC for driving in the UK (0.08%BAC),

18.31% considered themselves drunk (Additional file 3) but on BrAT realised that they could still legally drive a car. Consequently, easy access to BrAT in night time environments may increase the risk of those who feel drunk at lower blood alcohol levels attempting to drive home in the knowledge they are under the legal blood alcohol limit. Self-reported drunkenness was less common (10%, Additional file 3) in those within the typical European driving limit (up to 0.05%BAC) than in those between 0.05%BAC and the UK limit, where 29.03% considered themselves drunk (Additional file 3). Thus, moves to a lower legal %BAC limit for driving in the UK [44,45] could help prevent drunks driving, with less people who feel drunk identifying (e.g. through BrAT) that they are legally allowed to drive.

In our sample, half (51.16%) of those who considered themselves drunk at interview intended to consume more alcohol that night. In the UK and elsewhere it is illegal to sell alcohol to those who are drunk. However, research suggests that such laws are often ignored through, for example, commercial pressures to sell alcohol, low awareness and responsibility among bar servers, and difficulties recognising and refusing service to drunks [7-9]. Importantly, those breaking the law are rarely identified and penalised; in 2007 available data show just one individual (out of just seven proceeded against) was found guilty of selling alcohol to a drunk person in England and Wales, with 81 penalty notices for disorder (PNDs) issued for the same offence [22] (PNDs can be issued by police for certain alcohol-related offences, carrying a fine of £50-£80 to the offender). Findings here identify that a series of relatively simple behavioural observations are strongly correlated with drunkenness and %BAC (Additional file 3). Of those both unsteady on their feet and with a %BAC over 0.20, 83.33% self-assessed as drunk. Our results, and those of others, suggest that simple diagnostic observations of drunkenness (with or without BrAT measures) could be developed for nightlife settings and implemented by trained door and bar staff [20]. Along with such training, measures would have to be implemented to ensure staff feel confident about their own safety when refusing entry to a premises or service to a drunk and potentially aggressive individual. Critically however, such measures run counter to commercial interests. Thus, much of the alcohol sold in night time environments is consumed by those who are already drunk and, to a large extent, the economic viability of many late night businesses in the UK relies on patronage by drunks. Consequently, measures to reduce alcohol sales to drunk individuals are unlikely to be adopted unless made mandatory. However, properly implemented such measures could substantially reduce the number of drunk individuals who continue to access alcohol in nightlife environments and result in fewer highly inebriated individuals

leaving nightlife environments early in the morning or requiring health and judicial attention.

## Conclusions

Cities in the UK have adopted costly nightlife strategies aimed at protecting patrons from immediate alcohol-related harms, and controlling violence and other anti-social behaviour. Implementing safety measures in nightlife environments is crucial to protecting public health, yet without reasonable efforts to reduce nightlife alcohol consumption such measures may simply result in safer environments for drunks. Typically, assessment of nightlife uses police and emergency department data but ignores the underlying trends in excessive alcohol consumption. Here we have explored a novel method to expose underlying drinking behaviours and their progressive relationship with drunkenness during nights out. In particular, this approach provides a method for examining the more extreme levels of alcohol consumption associated with drinking into the early hours of the morning without either exposing researchers to highly inebriated consumers with poor recall or relying on estimations based on data from largely artificial, controlled and unrelated environments [46]. Although only preliminary, results using this methodology suggest, for instance, that preloading (typically with cheaper alcohol [5,47]) and drinking later into the night may be associated with higher levels of drunkenness in city centres. Initiatives informed by such intelligence may not only reduce acute harms and anti-social behaviours but also allow many adults who deliberately avoid heavy drinking cultures to re-engage with their city centres at night [48].

## Additional material

> **Additional file 1** Sample characteristics, drinking behaviours and blood alcohol levels at interview.
>
> **Additional file 2** Comparisons of drinking behaviour and blood alcohol concentrations at point of interview with estimated drinking behaviour over entire evening (up to estimated home time) and modelled blood alcohol concentration at intended home time.
>
> **Additional file 3** Relationship between individuals' blood alcohol concentration, self-assessment as drunk and researcher-assessed signs of drunkenness.

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## References

1. Hadfield P: *Nightlife and crime: social order and governance in international perspective* Oxford: Oxford University Press; 2009.
2. Hughes K, Jones L, Bellis MA: *Reducing harm in drinking environments* Liverpool: Centre for Public Health, Liverpool John Moores University; 2009.
3. Graham K, Homel R: *Raising the bar: preventing aggression in and around bars, pubs and clubs* Cullompton: Willan Publishing; 2008.
4. Hughes K, Bellis MA: *Use of environmental harm to tackle alcohol-related harm in nightlife environments: the UK experience* Lisbon: European Monitoring Centre of Drugs and Drug Addiction; 2007.
5. Hughes K, Anderson Z, Morleo M, Bellis MA: **Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes.** *Addiction* 2008, **103**:60-65.
6. Rydon P, Stockwell T, Lang E, Beel A: **Pseudo-drunk-patron evaluation of bar-staff compliance with Western Australian liquor law.** *Aust N Z J Public Health* 2008, **20**:290-295.
7. Wallin E, Gripenberg J, Andreasson S: **Too drunk for a beer? A study of overserving in Stockholm.** *Addiction* 2002, **97**:901-07.
8. Hughes K, Anderson Z: *Identifying drunkenness and preventing sales of alcohol to intoxicated customers in Manchester* Liverpool: Centre for Public Health, Liverpool John Moore University; 2008.
9. Reiling DM, Nusbaumer MR: **When problem servers pour in problematic places: alcoholic beverage servers' willingness to serve patrons beyond intoxication.** *Subst Use Misuse* 2006, **41**:653-668.
10. Drinkaware: *Free pints to tackle binge drinking among young adults. Press release* 2009 [http://www.drinkaware.co.uk/media/press-releases/2009-press-release-archive/free-pints-to-tackle-binge-drinking-among-young-adults].
11. Palk G, Davey J, Freeman J: **Policing alcohol-related incidents: a study of time and prevalence.** *Policing* 2007, **30**:82-92.
12. House of Commons Home Affairs Committee: *Home affairs - seventh report. London* 2008.
13. Strategy Unit: *Interim Analytical Report* London: Cabinet Office; 2003.
14. Warburton AL, Shepherd JP: **Tackling alcohol related violence in city centres: effect of emergency medicine and police intervention.** *Emerg Med J* 2006, **23**:12-17.
15. Maguire M, Nettleton H: *Reducing alcohol-related violence and disorder: an evaluation of the 'TASC' project* London: Home Office; 2003.
16. Bellis MA, Hughes K, Hughes S: *Interpersonal violence and alcohol* Geneva: World Health Organization; 2006.
17. Donnelly N, Poynton S, Weatherburn D, Bamford E, Nottage J: *Liquor outlet concentrations and alcohol-related neighbourhood problems* Sydney: NSW Bureau of Crime Statistics and Research; 2006.
18. Holborn PG, Nolana PF, Goltb J: **An analysis of fatal unintentional dwelling fires investigated by London Fire Brigade between 1996 and 2000.** *Fire Safety J* 2003, **38**:1-42.
19. Measham F: **The new policy mix: alcohol, harm minimisation, and determined drunkenness in contemporary society.** *Int J Drug Policy* 2006, **17**:258-268.
20. Perham N, Moore SC, Shepherd J, Busens B: **Identifying drunkenness in the night-time economy.** *Addiction* 2007, **102**:377-380.

21. Moore S, Shepherd J, Perham N, Cusens B: **The prevalence of alcohol intoxication in the night-time economy.** *Alcohol Alcohol* 2007, **42:**629-634.

22. House of Commons: *Parliamentary debates (Hansard), written answers* 2009 [http://services.parliament.uk/hansard/Commons/ByDate/20090609/writtenanswers/part008.html]. Alcohol drinks: crime

23. Stockwell T, Chikritzhs T: **Do relaxed trading hours for bars and clubs mean more relaxed drinking? A review of international research on the impacts of changes to permitted hours of drinking.** *Crime Prev Community Saf* 2009, **11:**153-170.

24. Thombs DL, O'Mara R, Dodd VJ, Hou W, Merves ML, Weiler RM, Pokorny SB, Goldberger BA, Reingle J, Werch CE: **A field study of bar-sponsored drink specials and their associations with patron intoxication.** *J Stud Alcohol Drugs* 2009, **70:**206-214.

25. Clapp JD, Reed MB, Min JW, Shillington AM, Croff JM, Holmes MR, Trim RS: **Blood alcohol concentrations among bar patrons: A multi-level study of drinking behavior.** *Drug Alcohol Depend* 2009, **102:**41-48.

26. Flint C: *Transport safety: the preliminary breath test device approval 2004* 2004 [http://police.homeoffice.gov.uk/publications/road-traffic-documents/transport-safety/transport-safety-breath-2004?view=Binary]. London: Home Office

27. Lion Laboratories Ltd: *Alcohol in the human body. Barry* 2000.

28. House of Commons Transport Committee: *Roads policing and technology: getting the right balance: government response to the Committee's tenth report of session 2005-06. Second special report of session 2006-07. London* 2007.

29. NHS Choices: **Unit calculator** [http://www.drinking.nhs.uk/questions/unit-calculator/]

30. Draper NR, Smith H: *Applied regression analysis* 3rd edition. New York: John Wiley and Sons; 1998.

31. Aldridge J, Charles V: **Researching the intoxicated: informed consent implications for alcohol and drug research.** *Drug Alcohol Depend* 2008, **93:**191-196.

32. Lange JE, Voas RB: **Defining binge drinking quantities through resulting blood alcohol concentrations.** *Psychol Addict Behav* 2001, **15:**310-316.

33. Posey D, Mozayani A: **The estimation of blood alcohol concentration: Widmark revisited.** *Forensic Sci Med Pathol* 2007, **3:**33-39.

34. Hustad JTP, Carey KB: **Using calculations to estimate blood alcohol concentrations for naturally occurring drinking episodes: a validity study.** *J Stud Alcohol* 2005, **66:**130-138.

35. Kraus CL, Salazar NC, Mitchell JR, Florin WD, Guenther B, Brady D, Swartzwelder SH, White AM: **Inconsistencies between actual and estimated blood alcohol concentrations in a field study of college students: do students really know how much they drink?** *Alcohol Clin Exp Res* 2005, **29:**1672-1676.

36. Department of Health: *Safe Sensible Social. The next steps in the national alcohol strategy. London* 2007.

37. Department of Health: *Sensible drinking: The report of an inter-departmental working group. London* 1995.

38. *The Licensing Act 2003* London: Her Majesty's Stationery Office; 2003.

39. Department for Culture, Media and Sport: *Evaluation of the Licensing Act 2003. Appendix C: Licensing Act 2003: Impact on terminal hour by market segment (i.e. actual closing times). London* 2008.

40. Llewellyn-Thomas S, Horup B: *Licensing Act 2003 and the effects of alcohol* London: TNS UK Ltd; 2008.

41. Cassell MM, Halperin DT, Shelton JD, Stanton D: **Risk compensation: the Achilles' heel of innovations in HIV prevention?** *BMJ* 2006, **332:**605-607.

42. Autier P: **Sunscreen abuse for intentional sun exposure.** *Brit J Dermatol* 2009, **161(S3):**40-45.

43. BBC: *Bar offered 'most drunk' reward* 2009 [http://news.bbc.co.uk/1/hi/england/tyne/8247107.stm].

44. Zador PL: **Alcohol-related relative risk of fatal driver injuries in relation to driver age and sex.** *J Stud Alcohol* 1991, **52:**302-310.

45. Allsop RE: *Reducing the BAC limit to 50 mg - what can we expect to gain?* London: Parliamentary Advisory Council for Transport Safety; 2005.

46. Bellis MA, Hughes K, Cook PA, Morleo M: *Off measure: how we underestimate how much we drink* London: Alcohol Concern; 2009.

47. Wells S, Graham K, Purcell J: **Policy implications of the widespread practice of 'pre-drinking' or 'pre-gaming' before going to public drinking establishments: are current prevention strategies backfiring?** *Addiction* 2009, **104:**4-9.

48. Cook PA, Tocque K, Morleo M, Bellis MA: *Opinions on the impact of alcohol on individuals and communities: early summary findings from the NorthWest Big Drink Debate* Liverpool: Centre for Public Health, Liverpool John Moores University; 2008.

# Alcohol, nightlife and violence: the relative contributions of drinking before and during nights out to negative health and criminal justice outcomes

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## ABSTRACT

**Aims** To explore differences in alcohol consumption and negative nightlife experiences between young people who drink prior to attending city nightlife venues and those who do not drink until reaching bars and nightclubs. **Design, setting and participants** A cross-sectional survey of 380 young people (aged 18–35 years) in bars and nightclubs in a large city centre in the North-west of England. **Measurements** An anonymous questionnaire explored participants' basic demographics; frequency of utilizing nightlife; quantities of alcohol consumed prior to and during a typical night out in the city; and negative experiences in the city's nightlife in the previous year [fighting, being verbally abused, being sexually molested (e.g. groped) and being too drunk to walk]. **Findings** Participants who reported drinking prior to attending nightlife (e.g. at their own or a friend's home) reported significantly higher total alcohol consumption over a night out than those not drinking until reaching bars and nightclubs. Over a quarter (26.5%) of female and 15.4% of male alcohol consumption over a night out occurred prior to attending nightlife. Individuals who drink before going out were over four times more likely to report drinking >20 units on a usual night out and 2.5 times more likely to have been involved in a fight in the city's nightlife during the previous 12 months. **Conclusions** Measures to tackle drunkenness and alcohol-related violence in nightlife should expand beyond those targeted solely at nightlife environments. Continued disparities in pricing and policing of alcohol between on- and off-licensed premises may increase at-home drinking prior to nights out and alcohol-related problems in residential areas.

**Keywords** Alcohol, intoxication, nightlife, violence, young people.

## INTRODUCTION

Preventing binge drinking and drunkenness in young people is an increasing global concern. Such drinking is particularly high in the United Kingdom [1,2]: by the age of 15 over a third of English schoolchildren drink at least weekly and 41% drink to get drunk [3]. This binge drinking culture extends to young adults, who prioritize participation in alcohol-focused nightlife for socializing and relaxing [4,5]. However, excessive drinking is linked to a wide range of health and social problems [6–8], especially violence [8–10]. Studies show that those who drink in greater quantities, drink more frequently and visit public drinking venues more often [11] are at increased risk of violence [12–14], and that intoxication is associ-

ated with increased aggression and severity of injury [15,16]. Availability of cheap alcohol is linked to greater consumption [17] and drinking venues that are poorly managed, uncomfortable and tolerant towards drunkenness experience higher levels of aggression [15,18,19].

Based on such evidence, interventions to reduce drunkenness and related problems in young people focus frequently upon nightlife environments. In the United Kingdom, vast resources are channelled into increasing security in nightlife areas [e.g. additional policing, closed circuit television (CCTV)] and improving practice in drinking venues (e.g. award schemes for good management) [20]. While such interventions have helped to reduce alcohol-related violence [18,21,22], they are not intended to reduce alcohol consumption *per se*. Further,

limiting alcohol harm reduction to nightlife environments neglects the roles played by other drinking locations and alcohol retailers in drunkenness and related problems. For example, young people often consume alcohol at home before a night out [6,23,24]. Alcohol can be purchased typically from off-licensed premises (e.g. shops, supermarkets) at substantially lower prices than on-licensed premises (e.g. bars, nightclubs, restaurants) [25], and trends in Britain show that off-licensed purchases account for an increasing proportion of alcohol sales [26].

To date, little research has examined pre-nightlife alcohol use and its impacts upon overall consumption and problems during a night out. Here we explore differences in quantities of alcohol consumed and negative nightlife experiences between those who drink before a night out (e.g. at their own or a friend's home) and those who do not use alcohol until reaching nightlife venues.

## METHODOLOGY

A short, anonymous questionnaire was developed for an exploratory study of young people's experiences of nightlife in a city centre in North-west England. Questions included: basic demographics; frequency of visiting pubs, bars and nightclubs; alcohol consumed prior to and during a typical night out; days consuming alcohol in the last week and experiences in the city's nightlife over the previous 12 months [being involved in a fight, sexually molested (e.g. groped), too drunk to walk, verbally abused]. The questionnaire was piloted among 100 individuals in eight bars in February 2006. Pilot results showed good completion and consistency across most variables, although three questions were removed and five added to clarify responses. For the main study, all on-licensed pubs and bars in the city centre were grouped according to their location in one of eight nightlife zones and 10% of venues from each zone were selected randomly. Where venues were unwilling ($n = 4$) or unable ($n = 7$, e.g. through closure) to participate, further venues in the same zone were selected randomly. The study ran from July to October 2006 in 18 venues. Questionnaires were administered opportunistically by researchers (5 p.m.–11 p.m., Mondays, Wednesdays, Thursdays, Fridays, Saturdays) who approached patrons who appeared to be aged 18–35 years. Potential participants were asked if they had time to complete a short survey ($n = 499$). Those who assented ($n = 424/499$; 85%) were given an explanation of the survey, assurance of anonymity, and asked if they would participate (compliance = 100%). The questionnaire was completed by researchers interviewing participants on a one-to-one basis. Researcher training included methodologies to measure alcohol consumption by assisting respondents

in understanding quantities, sizes and types of drinks. Researchers stressed that consumption estimates should relate to a usual, complete night out in the city centre rather than just a casual pub or bar visit, and should not simply describe the night of interview, allowing collection of data on individuals' typical nights out. Data were entered into SPSS and alcohol consumption data was converted to units as: one pint of lager/cider = 3; one single shot of spirits = 1; one bottle of alcopop = 1.5; one large glass of wine = 3 [27]. Prior to statistical analysis, 44 questionnaires were excluded; 21 were outside the study age range (18–35) and 23 due to inconsistencies in answers (thus $n = 380/499$; 76%).

## RESULTS

Approximately half (52.1%) the sample was male, mean age was 24.3 years, and most participants were employed (Table 1). Most participants visited pubs, bars or nightclubs at least weekly (83.9% anywhere; 65.3% specifically in the city centre). Three-quarters (77.4%) always drank alcohol when using the city's nightlife. Only 1.3% never drank alcohol on a night out and these were excluded from further analyses. Over half of drinkers (57.6%) used alcohol before going on a night out and genders did not differ significantly in units consumed pre-nightlife (Table 1). However, in public drinking premises, men reported drinking more than women (20.1 cf. 12.0 units, $F = 96.120$, $P < 0.001$). Consequently, total alcohol consumption (prior to and during a typical night out) was significantly higher among men (mean 23.7 units cf. 16.3 for women, $F = 63.831$, $P < 0.001$). A quarter (26.5%) of all alcohol consumed by females over a night out and 15.4% by males occurred prior to reaching public drinking premises. Among those drinking before going out, pre-nightlife alcohol use accounted for 38.1% of females' and 24.9% of males' total consumption.

While there were no differences in quantity of alcohol consumed in pubs, bars and nightclubs between those who drink before going out (15.8 units) and those who do not (16.8 units, $F = 1.709$, $P = 0.300$), combining alcohol use prior to and during a night out identified significantly higher consumption among pre-nightlife drinkers (22.7 cf. 16.8 units, $F = 37.803$, $P < 0.001$). Overall, 10.5% of participants had been involved in a fight in the city's nightlife in the past 12 months, and fighting was more likely among pre-nightlife drinkers (13.4% cf. 6.9%, $\chi^2 = 4.070$, $P < 0.05$). Such individuals also reported higher prevalence of being sexually molested (11.6% cf 5.0%, $\chi^2 = 4.944$, $P < 0.05$) and too drunk to walk (43.7% cf. 29.6%, $\chi^2 = 7.804$, $P < 0.01$).

Logistic regression analyses were used to identify factors independently related to negative experiences and

**Table 1** Sample characteristics, nightlife experience and alcohol consumption behaviour, by gender.

| | All<br>n = 380<br>% | Male<br>n = 198<br>% | Female<br>n = 182<br>% | P* |
|---|---|---|---|---|
| Age (years) | | | | |
| 18–24 | 61.1 | 59.1 | 63.2 | 0.413 |
| 25–35 | 38.9 | 40.9 | 36.8 | |
| Occupation | | | | |
| Student | 28.6 | 27.0 | 30.3 | 0.774 |
| Employed | 69.0 | 70.4 | 67.4 | |
| Unemployed | 2.4 | 2.6 | 2.2 | |
| Frequency of visiting pubs, bars and nightclubs | | | | |
| < Once a month | 3.7 | 2.0 | 5.5 | 0.179 |
| 1–3 days a month | 12.4 | 10.1 | 14.8 | |
| Once a week | 29.2 | 29.8 | 28.6 | |
| 2–4 days a week | 48.4 | 50.5 | 46.2 | |
| 5+ days a week | 6.3 | 7.6 | 4.9 | |
| Frequency of visiting pubs, bars and nightclubs in the city centre | | | | |
| < Once a month | 13.9 | 12.1 | 15.9 | 0.721 |
| 1–3 days a month | 20.8 | 20.2 | 21.4 | |
| Once a week | 28.7 | 31.3 | 25.8 | |
| 2–4 days a week | 32.4 | 32.3 | 32.4 | |
| 5+ days a week | 4.2 | 4.0 | 4.4 | |
| Frequency of alcohol use during a night out in the city | | | | |
| Always | 77.4 | 78.8 | 75.8 | 0.743 |
| Usually | 16.1 | 14.1 | 18.1 | |
| Occasionally | 5.3 | 5.6 | 4.9 | |
| Never | 1.3 | 1.5 | 1.1 | |
| Of those who drink in the city's nightlife | n = 375 | n = 195 | n = 180 | |
| % Drinking alcohol before a night out | 57.6 | 55.4 | 60.0 | 0.366 |
| Mean units consumed before a night out† | 6.9 | 6.6 | 7.2 | 0.228 |
| Mean units consumed in bars and nightclubs | 16.2 | 20.1 | 12.0 | < 0.001 |
| Mean units consumed in total (prior and during the night out) | 20.2 | 23.7 | 16.3 | < 0.001 |

Percentages may not add up due to rounding. *Statistics utilize $\chi^2$ for frequency comparisons and ANOVA for mean comparisons. †Limited to those who drink before a night out, n = 108 males, 108 females.

high alcohol consumption (> 20 units; pre- and during nightlife combined; Table 2). Here, those who drank pre-nightlife were 2.5 times more likely to have been in a fight and over four times as likely to drink > 20 units. Having been too drunk to walk increased with the quantity of alcohol consumed, while those drinking > 20 units were more than twice as likely to have been sexually molested. Students were significantly less likely to be involved in a fight and to drink > 20 units than other participants. Finally, those drinking on more than 1 day in the 7 days prior to survey were more likely to have been in a fight in the last 12 months, but with those drinking 2–4 days a week being at greatest risk.

## DISCUSSION

In the United Kingdom, binge drinking is defined frequently as drinking more than double the recommended daily limits (of 3 units for females, 4 units for males) [28],

and here more than 90% of both males and females binged typically on a night out. In fact, for both sexes, mean alcohol consumption exceeded total recommended weekly alcohol limits (females 14 units, males 21 units) [28]. Importantly, data show that individuals who drink before attending nightlife consume significantly more over a night out than those who do not, being over four times more likely to report drinking > 20 units. Pre-nightlife alcohol consumption may be undertaken to help people prepare for a night out or to accelerate drunkenness [6]. It may also be motivated financially due to lower off-licensed alcohol prices [25]. In this study, however, pre-nightlife drinking does not appear to be a substitute for consumption in nightlife; rather, those drinking before a night out drink similar amounts while out to those who do not.

Drinking before going out was associated with greater involvement in fighting in nightlife [odds ratio (OR) 2.5; Table 2]. However, total alcohol consumption was not

**Table 2** Adjusted odds ratios† for negative nightlife outcomes in the city the previous 12 months and drinking more than 20 units in a night out to the city.

| | Negative nightlife experiences in last 12 months | | | | | | | | Usual night out Drink > 20 units (n = 369) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Involved in a fight (n = 369) | | Verbally abused (n = 368) | | Sexually molested (n = 368) | | Too drunk to walk (n = 368) | | | |
| | AOR | 95% CI | AOR | 95% CI | AOR | 95% CI | AOR | 95% CI | AOR | 95% CI |
| Student | | | | | | | | | | |
| Yes (Ref) | ** | | NS | | NS | | NS | | * | |
| No | 4.757 | 1.62–13.96 | – | | – | | – | | 1.722 | 1.03–2.88 |
| Days drank in last week | | | | | | | | | | |
| 0–1 (Ref) | * | | ** | | NS | | NS | | NS | |
| 2–4 | 4.718 | 1.38–16.10 | 3.366 | 1.64–6.93 | – | | – | | – | |
| 5 or more | 1.594 | 0.34–7.51 | 3.424 | 1.50–7.82 | – | | – | | – | |
| Drink alcohol before going out | | | | | | | | | | |
| No (Ref) | * | | NS | | NS | | NS | | *** | |
| Yes | 2.575 | 1.22–5.45 | – | | – | | – | | 4.481 | 2.73–7.37 |
| Total units drank over a night out | | | | | | | | | | |
| 1–10 (Ref) | NS | | NS | | ** | | ** | | NA | |
| > 10–20 | – | | – | | 0.475 | 0.15–1.50 | 2.295 | 1.14–4.64 | | |
| > 20 units | – | | – | | 2.333 | 0.86–6.22 | 3.590 | 1.82–7.10 | | |
| Gender | | | | | | | | | | |
| Male (Ref) | NS | | NS | | *** | | NS | | *** | |
| Female | – | | – | | 6.697 | 2.65–16.90 | – | | 0.198 | 0.12–0.32 |
| Age (years) | | | | | | | | | | |
| 25–35 (Ref) | NS | | NS | | NS | | * | | NS | |
| 18–24 | – | | – | | – | | 1.679 | 1.07–2.64 | – | |

†Reference categories for each variable are identified with (Ref). Statistics utilize a stepwise backward conditional logistic regression analysis with variables that are not significant ($P = 0.05$) being removed from the model and subsequently the model recalculated. Such factors are identified with 'NS'. Significance is shown as *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. The variable 'total units drank over a night out' refers to alcohol consumed both prior to and during a night out; this variable was excluded from analyses for drinking over 20 units, marked 'NA'. AOR = adjusted odds ratio

associated with fighting, suggesting that pre-nightlife drinking may be a more important factor in nightlife violence than total consumption (which was linked to being too drunk to walk and sexual molestation). This supports findings elsewhere that the way in which people drink is important in predicting violence [29]. Several studies link intoxication to aggression [13,30] and individuals who drink before going out may reach intoxication earlier, thus spending longer periods in nightlife drunk and at risk of aggression. Such drinkers may also have different expectancies regarding drinking and aggression [31,32], or be more attracted to venues that are permissive to drunkenness and consequently linked with higher levels of aggression [15,18].

In the United Kingdom, measures to tackle drunkenness and related violence have focused largely on nightlife environments. In particular, pressures have been placed on bar and nightclub management to improve practice (e.g. train staff, end cheap alcohol promotions) and prevent the harms associated with their customers' drinking. However, while such interventions are important, this study suggests that focusing measures upon on-licensed retailers alone will be of limited effectiveness. For example, discouraging cheap alcohol sales in bars while permitting such sales in off-licensed premises may simply encourage more home drinking pre-nightlife. Here, those most affected would probably be young people [33] and individuals from deprived communities who have less expendable income (those already disproportionately affected by violence and alcohol) [34,35]. Increased pre-nightlife drinking may also reduce the amount people can consume in on-licensed premises before becoming intoxicated. Sale of alcohol to intoxicated individuals is illegal in the United Kingdom, and consequently bars and nightclubs may achieve fewer legal sales yet remain responsible for managing drunker customers. Further, entry refusal to intoxicated individuals could mean more drunk individuals on streets and more antisocial behaviour. Reduced sales in on-licensed premises may also lead managers to increase prices, further promoting home drinking or to increase irresponsible promotions (e.g. two-for-one offers) and cut costs elsewhere (e.g. fewer staff). With nightlife safety measures such as high-profile policing and CCTV frequently

absent in residential areas, pre-nightlife drinking may also increase alcohol-related problems, including violence, in the communities where drinkers live and on public transport as drinkers travel into nightlife areas.

Investment in better-managed drinking environments has resulted in significant progress in creating safer nightlife environments throughout the United Kingdom [20]. However, the role played by other alcohol retailers in intoxication and nightlife violence has largely been neglected. Results presented here highlight the relationships between on- and off-licensed alcohol consumption, and how pre-nightlife drinking is associated with higher consumption and violence during nights out. By asking people to describe their typical nights out respondents may have been affected by recall bias or even deliberately misreported consumption. However, by sampling in nightlife environments, individuals were prompted at least temporally and contextually about nightlife consumption. Remaining recall bias and misreporting effects are likely to reduce estimates of consumption [36], and consequently nights out (including pre-nightlife drinking, where self-poured alcohol measures can be greater than those served commercially [37]) could comprise even higher levels of bingeing. Regardless of such factors, our data show that those who drink pre-nightlife consume more and are at greater risk of involvement in nightlife violence. Consequently, there is a need to expand measures to prevent nightlife drunkenness and violence beyond pubs, bars and nightclubs. Such measures will require work with off-licensed vendors to improve retail practice (e.g. reducing irresponsible cheap promotions), with consumers to encourage safer drinking at home, and with public bodies including local authorities, criminal justice agencies and health services, who may not recognize home drinking as a part of wider nightlife problems. Overall, a balanced approach to the control of on- and off-licence sales should encourage alcohol consumption in moderation in all environments. Without such an approach, however, well-meaning initiatives to improve city centres may simply push excessive drinking and related problems, including violence, into home environments and local communities.

## Acknowledgements

## References

1. United Nations Childrens Fund (UNICEF). *An Overview of Child Well-Being in Rich Countries. A Comprehensive Assessment of the Lives and Well-Being of Children and Adolescents in the Economically Advanced Nations.* Florence: UNICEF Innocenti Research Centre; 2007.
2. Hibell B., Andersson B., Bjarnasson T., Ahlström S., Balakireva O., Kokkevi A. *et al. The ESPAD Report 2003: Alcohol and Other Drug Use Among Students in 35 European Countries.* Stockholm: The Swedish Council for Information on Alcohol and Other Drugs, CAN; 2004.
3. Fuller E., Bates B., Blenkinsop S., Boreham R., Hills A., Mcgee A. *et al. Smoking, Drinking and Drug Use Among Young People in England in 2004.* Leeds: Health and Social Care Information Centre; 2005.
4. Parker H., Williams L. Intoxicated weekends: young adults' work hard-play hard lifestyles, public health and public disorder. *Drugs Educ Prev Policy* 2003; **10**: 345–67.
5. Calafat A., Fernandez C., Juan M., Bellis M. A., Bohrn K., Hakkarainen P. *et al. Risk and Control in the Recreational Drug Culture.* Valencia: Irefrea; 2001.
6. Engineer R., Phillips A., Thompson J., Nicholls J. *Drunk and Disorderly: A Qualitative Study of Binge Drinking Among 18-to 24-Year-Olds.* Home Office Research Study 262. London: Home Office; 2003.
7. Johnson T. J., Stahl C. Sexual experiences associated with participation in drinking games. *J Gen Psychol* 2004; **131**: 304–20.
8. Matthews S., Richardson A. *Findings from the 2003 Offending, Crime and Justice Survey: Alcohol-Related Crime and Disorder.* Findings 261. London: Home Office; 2005.
9. Wells S., Graham K., Speechley M., Koval J. J. Drinking patterns, drinking contexts and alcohol-related aggression among late adolescents and young drinkers. *Addiction* 2005; **100**: 933–44.
10. World Health Organization. *WHO Facts on Youth Violence and Alcohol.* Geneva: World Health Organization; 2006.
11. Rossow I. Alcohol-related violence: the impact of drinking patterns and drinking context. *Addiction* 1996; **91**: 1651–61.
12. Swahn M. H., Donovan J. E. Predictors of fighting attributed to alcohol use among adolescent drinkers. *Addict Behav* 2005; **30**: 1317–34.
13. Wells S., Graham K. Aggression involving alcohol: relationship to drinking patterns and social context. *Addiction* 2003; **98**: 33–42.
14. Bonomo Y., Coffey C., Wolfe R., Lynskey M., Bowes G., Patton G. Adverse outcomes of alcohol use in adolescents. *Addiction* 2001; **96**: 1485–96.
15. Graham K., Bernards S., Osgood D. W., Wells S. Bad nights or bad bars? Multi-level analysis of environmental predictors of aggression in late-night large-capacity bars and clubs. *Addiction* 2006; **101**: 1569–80.
16. Leonard K. E., Quigley B. M., Collins R. L. Drinking, personality and bar environmental characteristics as predictors of involvement in barroom aggression. *Addict Behav* 2003; **28**: 1681–700.

17. Kuo M., Wechsler H., Greenberg P., Lee H. The marketing of alcohol to college students: the role of low prices and special promotions. *Am J Prev Med* 2003; **25**: 204–11.

18. Homel R., Carvolth R., Hauritz M., McIlwain G., Teague R. Making licensed venues safer for patrons: what environmental factors should be the focus of interventions? *Drug Alcohol Rev* 2004; **23**: 19–29.

19. Quigley B. M., Leonard K. E., Collins R. L. Characteristics of violent bars and bar patrons. *J Stud Alcohol* 2003; **64**: 765–72.

20. Hughes K., Bellis M. A. Use of environmental strategies to tackle alcohol-related harm in nightlife: the UK experience. *European Monitoring Centre for Drugs and Drug Addiction* 2007; in press.

21. Bellis M. A., Anderson Z., Hughes K. *Effects of the Alcohol Misuse Enforcement Campaigns and the Licensing Act 2003 on Violence*. Liverpool: Centre for Public Health, Liverpool John Moores University; 2006.

22. Wallin E., Norstrom T., Andreasson S. Alcohol prevention targeting licensed premises: a study of effects on violence. *J Stud Alcohol* 2002; **64**: 270–7.

23. McKinney A., Coyle K. Patterns of alcohol consumption in a Northern Irish sample. *Subst Use Misuse* 2005; **40**: 573–9.

24. Moriarty K. J., Gilmore I. T. Licensing Britain's alcohol epidemic. *Epidemiol Commun Health* 2006; **60**: 94.

25. Mintel. *In- vs Out-of-Home Drinking—UK—November 2003*. London: Mintel International Group Ltd; 2003.

26. Nielsen A. C. *Drink Pocket Book 2006*. Oxford: World Advertising Research Centre Ltd; 2005.

27. Department of Health. *How Much Is Too Much?* London: Department of Health; 2006.

28. Strategy Unit. *Interim Analytical Report*. London: Strategy Unit; 2003.

29. Kuntsche E. N., Gmel G. Emotional wellbeing and violence among social and solitary risky single occasion drinkers in adolescence. *Addiction* 2004; **98**: 331–9.

30. Graham K., Osgood D. W., Wells S., Stockwell T. To what extent is intoxication associated with aggression in bars? A multilevel analysis. *J Stud Alcohol* 2006; **67**: 382–90.

31. Ham L. S., Bonin M., Hope D. A. The role of drinking motives in social anxiety and alcohol use. *J Anxiety Disord* 2007; **21**: 991–1003.

32. Quigley B. M., Corbett A. B., Tedeschi J. T. Desired image of power, alcohol expectancies, and alcohol-related aggression. *Psychol Addict Behav* 2002; **16**: 318–24.

33. Laixuthai A., Chaloupka F. J. Youth alcohol and public policy. *Contemp Policy Issues* 1993; **11**: 70–81.

34. Bellis M. A., Hughes K., Tocque K., Hennell T., Humphrey G., Wyke S. Assessing and communicating the health and judicial impact of alcohol use. *Public Health* 2005; **119**: 253–61.

35. Howe A., Crilly M. Deprivation and violence in the community: a perspective from a UK Accident and Emergency Department. *Injury* 2001; **32**: 349–51.

36. Townshend J. M., Duka T. Patterns of alcohol drinking in a population of young social drinkers: a comparison of questionnaire and diary measures. *Alcohol Alcohol* 2002; **37**: 187–92.

37. Gill J. S., Donaghy M. Variation in the alcohol content of a 'drink' of wine and spirit poured by a sample of the Scottish population. *Health Educ Res* 2004; **19**: 485–91.