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Do pre-drinkers consume more alcohol than non-pre-drinkers on an event-specific night out? A cross-national panel mobile survey of young people's drinking in England and Denmark

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Abstract

Introduction and Aims. *Young people drinking heavily before going out to bars and clubs is associated with alcohol-related harm and therefore of great public concern. This study examines whether pre-drinkers consume more alcohol than non-pre-drinkers on an event-specific night out in England and Denmark—two European countries known for their excessive youth drinking.* ***Design and Methods.*** *An event-specific survey of 1298 young people conducted in 50 bars, pubs and nightclubs in England and Denmark and follow-up interviews conducted via mobile surveys (*n = *580). The questionnaire measured demographics, socioeconomic status, frequency of intoxication and alcohol unit intake before and during the young people's night out.* ***Results.*** *A mixed linear model performed on the panel mobile survey shows that pre-drinkers in England and Denmark consume 9.185 (*P < *0.001) and 7.554 (*P < *0.001) units, respectively, more than the non-pre-drinkers. However, in both countries pre-drinkers consume 3.430 (*P < *0.05) and 3.141 (*P < *0.001) units less alcohol on-premises than the non-pre-drinkers.* ***Discussion and Conclusion.*** *Pre-drinking is a widespread phenomenon in England and Denmark, with more than half of young people pre-drinking on an event-specific night out. Pre-drinking contributes significantly to high-intensity drinking, as it does not preclude further drinking in bars, clubs and pubs. Thus, pre-drinking is a major target for public measures seeking to reduce young people's intoxication-related drinking and alcohol-related harm.* [Østergaard J, Skov PR. Do pre-drinkers consume more alcohol than non-pre-drinkers on an event-specific night out? A cross-national panel mobile survey of young people's drinking in England and Denmark. *Drug Alcohol Rev* 2014;33:376–384]

Key words: alcohol, pre-drinking, young people, panel mobile survey, cross-national survey.

Introduction

Since the mid-1990s, cross-national surveys have established England and Denmark as the two leading drinking nations with the highest frequent heavy drinking and drunkenness among youth in Europe [1–3]. In both countries, young people drink alcohol with the explicit intention of reaching high levels of intoxication [4–6]. Furthermore, in both countries, alcohol is easily available from off-licensed premises (supermarkets and local shops) at considerably lower prices than from on-licensed premises (pubs, bars and clubs) [7], and drinking at home (i.e. pre-drinking) before going out at night is widespread. Current research estimates that among young people, approximately 60% in England and approximately 80% in Denmark pre-drink, consuming on average 6–11 units of alcohol before they go out [8,9].

The pre-drinking phenomenon has drawn increasing attention among alcohol and drug researchers [8,10–15], given its association with sudden high alcohol levels in the blood, thus increasing the risk of blackouts [16], alcohol poisoning [12] and violence [17]. Research suggests that young people pre-drink—usually at a private residence—to reach 'a sufficient level of intoxication to carry one through the main

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event of the evening with minimal further spending on alcohol' [11]. The definition implies that to save money, pre-drinkers purchase less alcohol on-premises than non-pre-drinkers. Some studies [15,18], however, suggest that pre-drinkers do not reduce their alcohol consumption on-premises or at least consume similar amounts as the non-pre-drinkers [8], concluding that pre-drinking considerably adds to young people's total alcohol consumption during an evening or night out.

In Denmark, the pre-drinking phenomenon is not well researched [19,20], despite evidence that pre-drinking is associated with high-intensity drinking. In England, previous studies on pre-drinking have relied on questions about 'usual' quantities of off-premises and on-premises drinking [8] and/or assessed their alcohol consumption (off- and on-premises) only at one point during a night out [21]. Both methods have limitations: the first is subject to increased recall bias, as people's ability to remember drinking occasions and number of drinks declines considerably after a few days [22,23]; the second does not record how pre-drinkers continue to drink for the rest of their night out.

Using event-level data, this study compares how pre-drinkers and non-pre-drinkers consume alcohol during their night out in England and Denmark. Event-level data capture overall alcohol consumption with either each day or event as an independent data point [24]. Compared with measurement relying on questions about usual quantities and frequency, event-level data are less subject to overreliance on conspicuous or recent events. To collect event-level data, we apply two different methods. Firstly, to measure alcohol consumption *immediately* following the pre-drinking event, researchers interview young people face-to-face in their natural drinking settings (*in situ* at bars, pubs and clubs). Secondly, for tracking how young people continue to drink throughout the night, an innovative follow-up mobile survey is applied. Thus, this study is one of few that cross-nationally [10] examine pre-drinking behaviour as it unfolds in natural settings [13].

Applying a mixed linear model to this unique panel mobile survey data, we estimate whether young people's pre-drinking results in increased alcohol consumption during their night out. As young people of lower socioeconomic status may have fewer means of participating in intoxicated-related drinking on-premises, and as research suggests that the quantity of drinking is influenced by educational achievement [25], we control for young people's education, occupation and income. Furthermore, as young people's overall drinking pattern can influence their likelihood of pre-drinking, we also control for how frequently they drink to intoxication.

Methods

The *in situ* survey (a two-page survey) was conducted in 50 licensed bars, pubs and clubs in England (26 venues) and Denmark (24 venues) during September/October 2011. In each country, four types of cities/towns were chosen for capturing potential variation in young people's drinking patterns: (i) London and Copenhagen; (ii) a city where university students dominate the nightlife; (iii) a town where a military base influences the composition of the night life crowd; and (iv) a seaside town particularly popular for drinking during young people's holidays. In each city/town, approximately six pubs, bars and clubs were contacted, and the bar owners/managers were promised full anonymity, including no mention of their city/town. The venues were chosen to represent a variety of drinking places: traditional pubs; upmarket drinking locations (often with a dance floor); mainstream drinking nightclubs; and corporately owned chain pubs/bars targeting younger people by offering 'inexpensive alcohol [26] such as happy hour and all-you-can-drink (for £10)' [27].

Two venues were unwilling to accommodate the interviews, and six venues were unable to accommodate them in an enclosed (often smoking) area. For the first two cases, two other venues with a similar profile agreed to participate. In the latter cases, with the owner/manager's approval, the survey was conducted outside the establishment. A refusal rate of 4% among venues is unlikely to introduce substantial sample bias. Nor is it likely that sample bias was introduced by our conducting the survey outside (not inside) only *six* venues, as young people in late summer/early autumn frequently stood outside the venues to have fresh air or a break or to smoke cigarettes. However, cigarette smokers are over-represented in our study when we compare the data to national representative surveys [28,29], but not when we compare our survey with previous club studies [9,21]. In our survey, 41% identified themselves as daily smokers and 21% as occasional smokers in England. Likewise in Denmark, 38% identified themselves as daily smokers and 18% as occasional smokers. We conducted initial analyses to test whether including young people's smoking status in our models made any significant difference to our primary covariate (amount of alcohol consumed). We also tested whether including the use of illegal drugs on the interview night (in both countries 6% reported having used or planned to use illegal drugs) made any significant difference to our primary covariate. As no such results were found, both smoking and illegal drug use were omitted from the models due to their potentially confounding other variables [30].

On Friday and Saturday nights between 9:00 pm and 5:00 am, six researchers approached young people who

appeared to be between the ages of 18 and 35, informing them that their participation was voluntary and confidential. If they completed the two-page *in situ* survey, they were asked whether they would like to participate in a mobile survey follow-up. If they agreed, they would send a text message with an identifiable code to a server, which then replied with information about the study, including the incentive of winning a £500 gift card. The follow-up interview, collected the following day, was based on both a user-friendly Internet-based mobile phone survey and an instant messaging platform survey, developed by Unwire (http://www.unwire.com). Thus, participants whose mobile phones had no Internet access could reply by text messaging. The study was approved by the Danish Data Protection Agency—the only ethics committee in Denmark.

The *in situ* survey included questions on gender, age, occupation, alcohol consumption, number of hours drinking and illegal drug use, questions adapted from the Lancashire Drug and Alcohol Action Team Phase One report [21,31]. Our survey also included questions on highest educational level (including current courses), average monthly *income* before tax and frequency of intoxication during the previous 30 days (for more details, see [19,20]).

Table 1 illustrates how we combined questions from the *in situ* survey with the follow-up mobile survey to measure the participants' alcohol consumption three times during their night out. The *in situ* survey asked the participants to list size, brand, type and number of alcoholic beverages they had consumed in an *off-premises drinking setting*, that is before they went out. The *in situ* survey also asked the participants how much alcohol they had been drinking *on-premises* (any pub, bar or club) until the time of the interview, again listing size, brand, type and number of alcoholic beverages. Using the English standard of one unit containing 8 grams of pure alcohol (in Denmark the standard unit is 12 grams) [32], off- and on-premises drinking was summed up to a continuous variable measuring units (for a similar definition, see [10]). From these two questions, we calculated the amount of alcohol units the participants' had been drinking, at the time of interview, in both *off-* and *on-premises setting*. The follow-up mobile survey provided us with information about the participants' total unit consumption during their night out. By deducting the combined off- and on-premises drinking measurement from total alcohol consumption measured by the follow-up mobile survey, we calculated the amount of alcohol units the participants consumed after they had been interviewed face-to-face in the *in situ* survey. Outliers were defined as persons who, when the three measures were combined, had consumed more than 60 units of alcohol. Few respondents (1.4% in England and 0.2% in Denmark) reported drinking more than the maximum of 60 units.

In England, the researchers approached 628 people; in Denmark, the researchers approached 670 people. The refusal rate was approximately 6% in each country (Table 2). The sample used for the descriptive analysis consists of 464 respondents for England and 531 for Denmark (Table 2). The mixed linear model uses the sample from the *in situ* survey combined with the follow-up mobile survey. When asked to participate in the mobile survey, young English people expressed lack of confidence about how their mobile number would be stored and fear that it would be used for commercial purposes. This lack of confidence resulted in only 64 valid answers for the combined *in situ* and follow-up mobile surveys for England (Table 2). In Denmark, the combined *in situ* and follow-up mobile survey consists of 204 valid answers for Denmark (Table 2).

Attrition analyses (Supporting Information Table S1, included as supplementary material) of the follow-up mobile survey (a logistic regression reporting statistical significant results at the 5% level) showed for Denmark that males, those with lower secondary education and those who spent more hours drinking, were more likely not to participate in the mobile survey. However, those who had been pre-drinking had a higher probability of participating. Thus, the attrition in the Danish data could bias our results upwards, and we may underestimate the difference in alcohol consumption between non-pre-drinkers and pre-drinkers. Attrition analysis of the follow-up mobile survey in England showed that

Table 1. *Surveys, alcohol consumption at different settings and construction of outcomes*

Survey	Alcohol consumption measured at each setting	Outcome variable used in the mixed model	Time (t)
In situ	Off-premises	Off-premises alcohol consumption	0
In situ	On-premises	Off-premises + on-premises alcohol consumption	1
Follow-up mobile survey	Total alcohol consumption during the night out	Total alcohol consumption (off-premises + on-premises alcohol consumption + alcohol consumption after *in situ* survey)	2

Table 2. *Participants in the in situ survey and follow-up mobile survey*

	England		Denmark	
Participants in the *in situ* survey	*n*	%	*n*	%
Number of respondents approached	628	100	670	100
Number of respondents who refused	36	5.73	39	5.82
Number of respondents who were too intoxicated	11	1.75	2	0.30
Number of respondents who were not 18–35 years old	20	3.18	29	4.33
Non-drinkers and incomplete/incorrect answers	97	15.45	69	10.29
Total number of respondents in the *in situ* survey	464	73.89	531	79.25
Participants in the follow-up mobile survey	*n*	% of *in situ* survey	*n*	% of *in situ* survey
Number of respondents who registered to participate	198	42.67	382	71.94
Number of completed responses the day following the interview	64	13.58	204	38.42

young people with an average monthly income of 1200–1799 GBP had a higher probability of not participating.

To take the repeated measures of alcohol consumption into account, we estimated a mixed model using STATA 13 (STATA Corp LP, College Station, TX, USA). This model estimated the total amount of alcohol consumed as a function of drinking settings. The mixed linear model allowed each person an intercept and growth trajectory to vary across drinking settings [33]. Variations within individuals, between individuals and between drinking settings estimated whether pre-drinkers consume more alcohol during their night out than the non-pre-drinkers [34]. To estimate the difference in young people's alcohol consumption at each setting, we estimated a model with an interaction term between the dummy variable measuring pre-drinking/not pre-drinking and a variable indicating when the alcohol consumption was measured at each setting: *off-premises* ($t = 0$), *on-premises* ($t = 1$) and during the remaining of the participants' night out (calculated from the follow-up mobile survey) ($t = 2$) (see Table 1).

The model included a correlation between the random intercepts and the random slopes. The correlation estimated the overlap of individual-specific regression lines. We included a dummy variable for each venue to take contextual effects (such as price differences and trading hours) into account. Participants at the same venues were exposed to the same contextual effects, such as the same alcohol prices and trading hours. A dummy variable for each venue take into account venue-specific fixed effects, for example prices and trading hours. All estimated models used the same control variables: gender, age, education, occupation, monthly income, number of times intoxicated during the previous 30 days and hours spent drinking. As the pre-drinkers are more likely to spread their alcohol consumption over more hours, we control for the number of hours the participants have been drinking until the time of the on-premises interview.

Due to the low response rate in the follow-up mobile survey in England, we fitted separate models for each country, using both the balanced and unbalanced panel data. This strategy also allowed us to discern country-specific patterns in alcohol consumption. For each country, we estimated two models. The first model (1a and 2a) estimated whether pre-drinkers drank more than non-pre-drinkers during their night out. The second model (1b and 2b) included the interaction term and estimated whether the pre-drinkers consumed more alcohol on-premises. To investigate whether the sample attrition affected the estimated models, we conducted sensitivity analyses based on unbalanced panels. The panels are unbalanced, as we do not have observations on all participants' alcohol consumption in all three drinking settings. If the results from the unbalanced data are very different from the results modelled on the balanced data, it could suggest that the attrition severely affects our estimations. The analyses of the unbalanced data (included as supplementary information, Supporting Information Table S2) support the results of the balanced data listed in Table 4. To further validate our results, we applied different specifications of the models (e.g. models using combined observations from both countries, with dummy variables controlling for country-specific and city/town-specific differences and examining country-clusters). However, they yielded no additional information. We also examined the within-individual change in alcohol consumption over time, applying a fixed effects model, which provided similar results on the variable of interest. This model, however, proved less efficient than the mixed linear model, so we preferred the latter models.

Results

Although more males (59%) participated in the *in situ* survey conducted in England than in the one in

Table 3. *Sample characteristic by country based on the in situ survey, percentages and means*

	England				Denmark				
Categorical variables	Percentages				Percentages				Difference between England and Denmark
Pre-drink on the night of interview (%)	64				74				***
Male (%)	59				52				*
Education									***
Lower secondary (%)	9				6				
Upper secondary (%)	27				46				
Diploma/BA (%)	47				23				
MA (%)	16				25				
Occupation									***
School/university (%)	24				56				
Employed (%)	73				40				
Unemployed/job training scheme (%)	3				4				
Average monthly income									***
Under 1200 GBP (%)	40				46				
1200–1799 GBP (%)	25				19				
1800–3000 GBP (%)	25				18				
More than 3000 GBP (%)	11				17				
Continuous variables	Means	SD	Min	Max	Means	SD	Min	Max	
Age	23.26	4.02	18	35	22.95	4.26	18	35	
Off-premises units consumption[a]	8.78	7.47	1	45.2	10.80	7.15	1.52	45	***
Off-premises + on-premises units consumption—at the time of interview	14.69	10.49	1.3	60	14.45	9.57	0	60	
Total unit consumption during the night out[b]	20.42	14.49	2.8	60	17.07	9.14	0	47.5	*
Number of times drunk previous 30 days	4.99	3.73	0	11	3.43	3.39	0	11	***
Hours spent drinking by the time of interview[c]	4.05	2.48	0	13.33	5.08	3.36	0	29.92	***
n	464				531				

Note: SD = standard deviation; ***$P < 0.001$; **$P < 0.01$; *$P < 0.05$; [a]Only pre-drinkers; [b]Based only on the participants in the follow-up mobile survey ($n = 64$ for England and $n = 204$ for Denmark). [c]Based on 459 observations for England. The difference between the two countries on the categorical variables has been tested using a χ^2 test. The difference between the two countries on the continuous variables has been tested using a *t*-test.

Denmark (52%), females were less likely to participate in either country (Table 3). That females are less likely to participate in bar and club surveys is consistent with other studies [8,31,35]. In both countries, the mean age was 23 years. Pre-drinking on the night of the interview was more common among young Danes (74%) than among the young English people (64%), and on average those who pre-drank in Denmark consumed more units (11 units) than their counterparts in England (nine units).

Table 4 shows the results of the mixed linear models for each country. Models 1a and 2a were without the interaction term between pre-drinking and setting, whereas models 1b and 2b were with the interaction term. In both countries (models 1a and 2a), pre-drinkers consumed more alcohol than non-pre-drinkers on an event-specific night out. Pre-drinkers in England consumed on average 7.7 units more than non-pre-drinkers. In Denmark, pre-drinkers consumed on average 6.6 units more than non-pre-drinkers.

In England, the only individual characteristics that could explain increased alcohol consumption were hours spent drinking and being employed. In Denmark, hours spent drinking, being male and having been frequently intoxicated in the preceding 30 days were associated with larger quantities of alcohol consumption on the event-specific night out.

Models 1b and 2b include the interaction, which estimated the differences in pre-drinkers' and non-pre-drinkers' unit consumption at each drinking setting. As the coefficient was negative in both countries, pre-drinkers drank less alcohol on-premises than the non-pre-drinkers. In England, when at a bar, club or pub, the pre-drinkers consumed 3.4 units of alcohol less than the non-pre-drinkers. In Denmark, the pre-drinkers drank 3.1 units of alcohol less on-premises than the non-pre-drinkers. Thus, pre-drinkers slowed down their intake of alcohol during the night out (i.e. on-premises), whereas non-pre-drinkers drank more heavily at the bars, clubs and pubs.

Table 4. *Mixed linear model based on complete answers from the combined in situ survey and the mobile follow-up survey conducted in England and Denmark. Standard errors are in parentheses. Estimations include venue-specific dummy variables*

	England				Denmark			
	1a		1b		2a		2b	
	Total number of units		Total number of units		Total number of units		Total number of units	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Off-premises drinking setting (pre-drinking)	7.677***	(1.993)	9.185***	(2.104)	6.643***	(0.995)	7.554***	(1.009)
Drinking setting	7.092***	(0.780)	9.129***	(1.178)	4.519***	(0.264)	6.952***	(0.520)
Interaction between pre-drinking and drinking setting			−3.430*	(1.529)			−3.141***	(0.591)
Male	3.478	(1.894)	3.478	(1.894)	2.044**	(0.793)	2.044**	(0.793)
Age	−0.272	(0.267)	−0.272	(0.267)	−0.0836	(0.125)	−0.0836	(0.125)
Number of times intoxicated last 30 days	0.227	(0.218)	0.227	(0.218)	0.404***	(0.112)	0.404***	(0.112)
Hours spent drinking	1.784***	(0.322)	1.784***	(0.322)	0.908***	(0.161)	0.908***	(0.161)
Education								
Lower secondary (ref.)								
Upper secondary	1.459	(2.247)	1.459	(2.247)	−0.839	(1.084)	−0.839	(1.084)
Diploma/BA	−0.117	(3.959)	−0.117	(3.959)	−0.00490	(1.207)	−0.00490	(1.207)
MA	3.433	(2.233)	3.433	(2.233)	−3.102	(1.678)	−3.102	(1.678)
Occupation								
Student/university (ref.)								
Employed	7.806**	(2.556)	7.806**	(2.556)	1.047	(1.181)	1.047	(1.181)
Unemployed/job training	−0.276	(3.879)	−0.276	(3.879)	2.414	(1.787)	2.414	(1.787)
Monthly income								
Under 1200 GBP (ref.)								
1200–1799 GBP	−3.255	(2.367)	−3.255	(2.367)	0.366	(1.006)	0.366	(1.006)
1800–3000 GBP	−4.265	(2.588)	−4.265	(2.588)	−1.163	(1.174)	−1.163	(1.174)
More than 3000 GBP	−2.826	(4.099)	−2.826	(4.099)	0.540	(1.700)	0.540	(1.700)
Constant	5.701	(6.257)	4.805	(6.269)	−4.013	(3.694)	−4.718	(3.696)
Random effects								
Random slope (SD)	5.282***	(0.677)	5.006***	(0.666)	2.651***	(0.296)	2.304***	(0.308)
Random intercept (SD)	3.214***	(1.100)	3.127**	(1.089)	3.434***	(0.393)	3.413***	(0.390)
Within individual (SD)	4.694***	(0.415)	4.694***	(0.415)	3.777***	(0.187)	3.777***	(0.187)
Correlation between random intercept and random slope	−0.359	(0.277)	−0.309	(0.296)	0.333	(0.242)	0.449	(0.271)
Venue-specific dummy variables	Yes		Yes		Yes		Yes	
n	192		192		612		612	

Note: ***$P < 0.001$; **$P < 0.01$; *$P < 0.05$. In the table, each individual is counted three times. Each model includes venue-specific dummies. The number of dummy variables included corresponds to the number of venues in the specific country; 26 for England and 24 for Denmark.

Discussion

The findings from the *in situ* survey collected in 50 bars and clubs in England and Denmark showed that 64% of the young English people and 74% of the young Danes pre-drink before a night out making pre-drinking among young people more common in Denmark. However, in both countries, pre-drinking contributed significantly to high-intensity drinking. As the mixed linear model revealed during a night out, pre-drinkers consumed 6–8 more units than non-pre-drinkers. Thus, our study supports previous studies [8,13] that pre-drinking increases young people's overall units consumption on a night out. However, while previous findings from England [8] suggest that pre-drinkers consume more alcohol than non-pre-drinkers on premises, our study found that when both groups drank on-premises, the pre-drinkers drank on average approximately 3–4 units less than the non-pre-drinkers. Our different result may be due to, firstly, our measuring on- and off-premises drinking as event-level data, not as a usual night out (a measurement likely to rely on salient events). Secondly, we do not measure alcohol consumption only at a single point, but follow up on it the day after their night out.

Our result is supported by a similar study of young people's pre-drinking in Switzerland [13]. Using event-level data, they found that on evenings when young people were pre-drinking off-premises, their alcohol consumption on-premises was slightly lower than on evenings where they were only drinking on-premises, although the difference was not statistically significant. They also found that on evenings with pre-drinking, young people consumed far more units of alcohol than on evenings where they would either drink only on-premises or off-premises. Following the same individuals over multiple evenings, they concluded that the large difference in overall alcohol consumption on pre-drinking versus non-pre-drinking evenings was not related to the type of people who pre-drink.

Although our study compared pre-drinkers with non-pre-drinkers on a specific night out, it also found that pre-drinkers' higher alcohol consumption can only to a limited degree be attributable to their being different from non-pre-drinkers. In Denmark, however, being male and frequently drinking to intoxication are factors associated with increased alcohol intake on a night out. In both countries, drinking for a longer duration is association with high-intensity drinking. Thus, pre-drinkers in both countries participate more greatly in the intoxication-related going-out culture by drinking themselves to intoxication more frequently and use pre-drinking at home to achieve this level of drunkenness.

Our study has several limitations. Firstly, the low number of participants in the follow-up mobile survey, particularly in England, questions the validity of our results. Therefore, we conducted additional analyses of the unbalanced panel data (Supporting Information Table S2). The results supported our finding that pre-drinkers consumed more units of alcohol than non-pre-drinkers but slowed down their drinking on-premises. Secondly, it is a non-random sample of young pub-, bar- and club-goers in Denmark and England. Therefore, we used the venue-specific dummy variables to take potential venue-specific heterogeneity into account. Furthermore, we applied different models (including a fixed effect model taking into account unobserved heterogeneity) to our data and found similar results.

Thirdly, for ethical reasons, *overly* intoxicated respondents (identified as those who could not speak clearly or who were staggering) were not approached for interviewing. In our experience (i.e. 14 cases excluded from the analyses; Table 2), extremely intoxicated people could not remain focused enough to complete the survey: they had great difficulties in listing the size, brand, type or number of alcoholic beverages they had consumed before and during their night out. Thus, interviewing extremely intoxicated people would most likely add unnecessary bias, particularly to the estimate of unit consumption. However, our study did not exclude interviewing intoxicated people. In both countries, our survey found that young people had consumed on average 15 units (Table 3) when they were interviewed at the bar, club or pub. Thus, although most of the participants were intoxicated, some even highly, they were only included in the study if they could stay focused to report valid answers and complete the interview.

A fourth limitation is that the *in situ* survey did not measure other factors, such as energy drinks, which could potentially influence young adults' alcohol consumption. A recent study suggests that although energy drinks are not frequently consumed by young people in Denmark, drinking to intoxication is more common among those who report weekly consumption of energy drinks [36]. Studies from the USA also reveal that young people who combine energy drinks with alcohol have an increased risk of experiencing alcohol-related consequences, including drinking to intoxication [37,38]. Thus, future studies could benefit from including questions on energy drinks when researching young people's alcohol consumption on a specific night out. Finally, our study did not measure young people's alcohol consumption continuously during the young people's night out. Although asking young people to participate throughout the night could reduce recall bias, doing so could potentially reduce their interest in participating in the study, particularly in England, where participants were very sceptical of signing up for

a mobile study. Furthermore, it could also encourage some respondents to drink more than they would have otherwise. Future studies, however, could benefit from investigating what effect continuous reporting of alcohol consumption during a night out has on young people's alcohol consumption and on attrition.

The advantage of our study is that we applied an identical method to investigate pre-drinking in two European countries in which young people drink most excessively. By measuring pre-drinking as event-level data and by following up on young people's drinking immediately after their night out, our study is likely to have reduced recall bias in estimating the consumption of units. Thus, our cross-national panel study shows that in England and Denmark pre-drinkers do not buy as many drinks on-premises as they would have otherwise, suggesting that at home they become sufficiently intoxicated to carry them through the night.

For reducing both the prevalence and the amount of alcohol that young people pre-drink, our study points to the need for public measures to address the striking price divergence in on- and off-licence alcohol (e.g. by introducing minimum alcohol pricing per unit) [39,40]. In England, this price divergence has developed over the last two decades. For example, in the early 1990s, beer, wine and spirits cost about the same in pubs and supermarkets [7], but by the end of 2010, on-licensed beer cost approximately 30% more and on-licensed wines and spirits cost over 25% more than in 1990. Unfortunately, such information could not be obtained for Denmark. Other measures for reducing pre-drinking among young people could be restricting highly intoxicated people's access to venues and training bar staff in responsible alcohol beverage service and conflict management. Finally, alcohol education programmes aimed at schools should emphasise the risks associated with the increased alcohol consumption resulting from combining pre-drinking with drinking in pubs, bars and clubs.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Table S1. Logistic regression model on attrition from the *in situ* survey and the follow-up mobile survey conducted in England and Denmark. Odds ratios. Standard errors are in parenthesis.
Table S2. Mixed linear model based on *all* available observations (i.e. unbalanced panel data) from the *in situ* survey and the follow-up mobile survey conducted in England and Denmark. Standard errors are in parenthesis. Estimations include venue-specific dummy variables.