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Drinking locations and alcohol-related harm: Cross-sectional and longitudinal associations in a sample of young Swiss men

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Abstract

Background. Alcohol consumption—in particular drinking volume (DV) and risky single occasion drinking (RSOD)—has been related to a wide range of negative consequences and health problems. Previous studies also suggested that drinking in certain locations may be more strongly associated with the occurrence of alcohol-related harm than drinking in others. However, they were conducted in countries culturally and legally different from European countries and were limited to cross-sectional designs. This study investigates the cross-sectional and longitudinal associations of alcohol-related harm with DVs in different locations in a sample of young Swiss men.

Methods. A representative sample of 4,536 young Swiss male drinkers completed baseline and 15-month follow-up questionnaires. These assessed DVs in 11 locations, alcohol-related harm (i.e. number of alcohol-related consequences and alcohol use disorder criteria) and frequency of RSOD. Cross-sectional and longitudinal associations of alcohol-related harm with DVs in each location were tested using regression models, with and without adjustment for frequency of RSOD.

Results. Both cross-sectional and longitudinal analyses showed significant positive associations between alcohol-related harm and DVs at friends' homes, in discos/nightclubs and in outdoor public places, when controlling for frequency of RSOD. In contrast, the contribution of DVs at one's own home and in restaurants was consistently not significant when adjusted for frequency of RSOD. When controlling for RSOD, associations between alcohol-related harm and DVs in

bars/pubs, when playing sports, during other leisure activities, at cinemas/theatres, during sporting events, and during special events were not consistent between cross-sectional and longitudinal analyses.

Conclusion. Results suggest that prevention interventions should not only target reducing the overall volume of alcohol consumed and the frequency of RSOD in general, but they should additionally focus on limiting alcohol consumption in outdoor public places, discos/nightclubs, and in friends' homes in particular, or at least on preventing harm occurring in these occasions.

Word count: 300 (max. 300)

Keywords: alcohol use, drinking location, alcohol-related consequences, alcohol use disorders, young adults, Switzerland.

Introduction

Alcohol use is one of the main risk factor for mortality and morbidity (Rehm, Taylor, & Room, 2006). Among adolescents and young adults more specifically, risky single occasion drinking (RSOD), also called binge drinking or heavy episodic drinking, commonly measured as drinking 5 or more or 6 or more drinks on one occasion, e.g. about 60 grams of pure ethanol (Gmel, Kuntsche, & Rehm, 2011), is one of the stronger predictor of alcohol related harm, such as blackouts, regretted actions, unintended or unprotected sexual intercourse, accidents, problems with the police, academic failure, damage to property, and violence are now well established (e.g. Gmel, Rehm, & Kuntsche, 2003; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Some studies showed that the location where drinking occurs also accounts for a substantial part of alcohol-related harm (Bersamin, Paschall, Saltz, & Zamboanga, 2011; Casswell, Zhang, & Wyllie, 1993; Mihic, Wells, Graham, Tremblay, & Demers, 2009; Nyaronga, Greenfield, & McDaniel, 2009; Rossow, 1996; Single & Wortley, 1993; Stockwell, Lang, & Rydon, 1993; Stockwell, Somerford, & Ernie, 1992; Treno, Alaniz, & Gruenewald, 2000; Usdan, Moore, Schumacher, & Talbott, 2005; Walker, Waiters, Grube, & Chen, 2005; Wells, Graham, Speechley, & Koval, 2005; Wells, Mihic, Tremblay, Graham, & Demers, 2008). However, these studies were limited to cross-sectional design and most of them were conducted in North America and Oceania. As these countries may not be culturally and legally comparable with European countries, studies are needed to investigate how drinking locations relate with alcohol-related harm in European countries. The present study aimed to examine this question in a sample of Swiss young men, using cross-sectional and longitudinal analyses. A better understanding of the associations between drinking locations and alcohol-related harm may help

to focus prevention interventions on the locations where drinking has the severest consequences (Kuntsche & Gmel, 2013; Treno et al., 2000).

It is almost impossible to compare the existing evidence for the association between drinking locations in general, and with the present study on young men aged around 20 years more specifically.

First, many studies used general population samples as regards age, thus combining underage drinkers with the majority of drinkers at legal drinking age and even more so a majority of drinkers being much older than in the present study (Casswell et al., 1993; Nyaronga et al., 2009; Rossow, 1996; Stockwell et al., 1993; Treno et al., 2000). These studies suggest that drinking in public locations increases the occurrence of alcohol-related harm in comparison to drinking in private settings such as at home or other's home. Among public (on-premise) drinking locations, drinking in bars, hotels, or nightclubs was found to be more strongly related to incidents of alcohol-related harm than drinking in locations such as restaurants (Casswell et al., 1993; Single & Wortley, 1993; Stockwell et al., 1993; Stockwell et al., 1992). However, for adult drinkers, moderate drinking at home may be the norm and drinking outside the home may represent more special drinking occasions and therefore reflect increased drinking leading to harm. Moreover, for overall older population samples, drinking in pubs and bars is commonly not regulated by legal drinking age restrictions.

Conversely, for younger samples (around 17-25 years) there is evidence of significant positive associations between alcohol-related harm and drinking in private settings. For example, driving while being drunk has been related to drinking at friends' homes (Usdan et al., 2005) and to drinking in cars themselves (Walker et al., 2005). The occurrence of alcohol-related sexual intercourse with a stranger (associated with increased risk of sexual transmitted infection) was

more strongly related to attending non-public parties, such as fraternity, sorority and halls of residence parties or parties in private homes, than to attending settings such as bars, restaurants, campus events, parks, and beaches (Bersamin et al., 2011). Drinking at a hall of residence or a fraternity was also associated with a higher occurrence of involvement in conflicts, arguments or fights than drinking elsewhere (Mihic et al., 2009; Wells et al., 2008). These studies, however, mainly come from North America, and there from college student samples. In the US, the legal drinking age in these studies was 21 years (in Canada: 18 years for fermented beverages and 19 for spirits). Thus, for a majority of the samples, drinking in public venues may just not be allowed or heavy drinking is more strongly supervised, e.g. by enforced responsible serving practices, than in European countries. In addition, the concept of fraternities and sororities (applying to students only) is less widespread in Europe, and drinking in these locations is less common at European universities, where alcohol use at this age is legally permitted and thus occurs at many locations. Drinking at universities and colleges is obviously less relevant for young adults not going to universities or colleges, and college students, at least in the US, come commonly from highly affluent families, thus biasing samples to well educated affluent young people with culturally determined drinking practices in university/college environments.

Also, some studies (e.g. Bersamin et al., 2011; Rossow, 1996; Stockwell et al., 1993; Treno et al., 2000) clustered together different locations which may have completely different associations as regards harm, such as bars and restaurants. This may mask the specific effect of each location: for example, clustering restaurants and pubs as on-premise drinking locations may mask effects related to bars only.

In Europe, there are to our knowledge, only two studies, examining the association between drinking locations and alcohol-related harm, and both grouped drinking location in two

categories. Rossow (1996) compared public versus non-public locations in a sample of the Norvegian general population (aged 15+ years) including some underaged drinkers but consisting of a majority participants at legal drinking age. They showed that involvement in alcohol-related violence was positively associated with public drinking locations. More recently, results of a study in Switzerland (Bähler et al., 2014) showed that drinking locations clustered in "party" vs. "non-party" drinking locations, based on principal component analysis, suggesting that a distinction between "party" and "private" drinking locations may be more relevant than one related to "public" vs. "private" drinking locations. "Party" drinking locations (including drinking at home, in friends' homes, pubs/bars, discos/nightclubs, outdoor public places, special events) were associated with more alcohol-related consequences than "non-party" drinking locations (including drinking at the theater/cinema, sport clubs, other clubs/societies, restaurants, and sporting events). However, the clustering of different locations does not mean that each distinct "party" drinking location is uniquely related to alcohol-related harm, and therefore could not answer the question of what specific locations were or were not related to harm.

To sum up, previous studies have yielded inconsistent findings regarding what locations are particularly related with harm, and further research is needed to identify more precisely the specific drinking locations that are significantly associated with alcohol-related consequences. Some studies are simply outdated (Casswell et al., 1993; Single & Wortley, 1993; Stockwell et al., 1993; Stockwell et al., 1992), and other more recent studies often used convenience samples of students (Bersamin et al., 2011; Mihic et al., 2009; Usdan et al., 2005; Wells et al., 2008). Moreover, most of the existing studies were conducted in North American countries that may have a different drinking culture and legal system regulating alcohol use compared to Switzerland and other European countries (World Health Organization, 2014). Thus, the results

of previous studies may not be generalizable to non-students or to European countries such as Switzerland. Finally, to the best of our knowledge, all the studies to date linking drinking locations and alcohol-related harm focused exclusively on cross-sectional associations and none of them examined longitudinal associations. Thus, new studies are needed to examine whether changes in drinking habits in specific locations covary with changes in the corresponding consequences.

Given the limitations in comparing our study with previous studies, we can only sketch out some working hypotheses. The first aim was to explore the cross-sectional associations of alcohol-related harm with the use of alcohol in 11 distinct drinking locations in a population-based sample of Swiss young men, and thus separating out a multitude of different locations. We hypothesize that in a drinking culture where alcohol use is legally permitted already at the age of 16 (for fermented beverages) and regulations are commonly not strongly enforced, drinking of young adults may lead to harm particularly also in public locations (bar/pub/discotheques, public places such as streets and parks), for which drinking at this age is prohibited in other jurisdictions. The second aim was to examine the longitudinal associations between drinking location and harm. This was tested by using first differences in drinking and harm over a 15-months period. We hypothesize that a causal effect of drinking locations will be substantiated by showing that changes in drinking in particular locations are related with changes in alcohol-related harms.

Methods

Study design and participants

All data were drawn from the Cohort Study on Substance Use Risk Factors (C-SURF, research protocol number 15/07, approved by Lausanne University Medical School's Ethics

Committee for Clinical Research). C-SURF is a longitudinal study designed to investigate the risk and protective factors of substance use in emerging adulthood. Participants were enrolled in three of Switzerland's six army recruitment centers, covering 21 of its 26 cantons. As army recruitment is mandatory for 20-year-old Swiss males, virtually all young males of this age in the cantons covered by the three army recruitment centers were eligible for participation in the study. Army recruitment centers were used to inform and enroll participants, but the study was independent of any army influence or procedures as filling out the baseline and follow-up questionnaires was carried out confidentially at home (see Studer, Baggio, et al., 2013; Studer, Mohler-Kuo, et al., 2013, for more information on enrolment procedure).

A total of 7,563 participants gave written consent to participate in the study and, of these, 5,990 (79.2%) completed the baseline questionnaire at home between September 2010 and March 2012. A total of 5,223 participants (87.2% of the baseline respondents) completed the follow-up questionnaire between March 2012 and April 2013 (average time-lag between baseline and follow-up: M = 15.53 months; SD = 2.76). Non-response analysis showed that non-respondents reported using both more alcohol and more frequent RSOD than respondents, but the differences were small and only significant due to large sample size. This resulted in a small non-response bias (Studer, Baggio, et al., 2013; Studer, Mohler-Kuo, et al., 2013). Alcohol-related harm was only assessed on those who had used alcohol in the previous 12 months. Hence, 532 (10.2% of follow-up participants) abstinent respondents (at baseline and/or at follow-up) were excluded. Missing values were listwise deleted, resulting in a final sample of 4,536 participants (96.7% of the 4,691 consistent alcohol users).

Measures

Alcohol-related harm

1. **Alcohol-related consequences.** At baseline and follow-up, participants were asked whether they had experienced a series of 10 consequences during the previous 12 months because of their own alcohol use. The consequences, selected from the College Alcohol Study (Knight et al., 2002; Wechsler et al., 1994), included getting in trouble with the police, using alcohol or medicine to get over the effects of a hangover, having a mental blackout, doing something regretted later, having unplanned sex, having sex without a condom, having an accident or being injured, having an argument or a fight, damage to property, and missing school or neglecting work or family obligations. The consequences experienced in the previous 12 months were summed to get the number of alcohol-related consequences ranging from 0 to 10. These consequences measure mainly acute harms from drinking.
2. **DSM-5 alcohol use disorder (AUD) criteria.** At baseline and follow-up, participants were asked whether they had experienced any of the 11 criteria for AUD referenced by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013). Criteria included: 1) tolerance; 2) withdrawal symptoms; 3) using larger amounts and for longer periods than intended; 4) desire to cut down alcohol use, without success; 5) spending a great deal of time obtaining, consuming or recovering from the effects of alcohol; 6) giving up important activities because of drinking; 7) continued drinking despite awareness that alcohol had repeatedly caused anxiety, depression or health problems; 8) drinking in hazardous situations; 9) failure to fulfill major role obligations at work/school/home; 10) continued use despite persistent or recurrent social or interpersonal problems due to drinking; and 11) cravings and urges to consume alcohol. Criteria experienced in

the previous 12 months were summed to get the number of DSM-5 AUD criteria ranging from 0 to 11. AUD-criteria were used to measure more chronic harms from drinking.

Alcohol consumption

1. **Drinking locations.** At both baseline and follow-up, usual 12-month DVs in 11 different drinking locations were assessed using a quantity-frequency measure adapted from the New Zealand National Alcohol Tracking Survey (Habgood, Casswell, Pledger, & Bhatta, 2001). Selected drinking locations were: 1) at home; 2) at friends' homes; 3) in bars/pubs; 4) in discos/nightclubs; 5) in restaurants; 6) when playing sports; 7) during other leisure activities (e.g. when playing music, at the shooting club); 8) at theatres/cinemas; 9) during sporting events; 10) in outdoor public places (e.g. parks, streets); and 11) at special events (e.g. festivals, youth parties). For each drinking location, weekly DV (in number of drinks) was calculated by multiplying the respective usual frequency of drinking occasions by the usual quantity of standard drinks per occasion. Pictures of standard drinks containing approximately 10–12 g of pure alcohol were provided. Total DV was also calculated by summing DVs for all specific locations.
2. **Frequency of RSOD.** Baseline and follow-up frequency of RSOD—defined as drinking occasions with at least six standard drinks—were measured using a single item asking how many episodes of RSOD participants had had in the previous 12 months. This was coded into a three-level categorical variable: no, or less than monthly RSOD; monthly RSOD; and more than monthly RSOD. RSOD item was not

location-specific, and therefore measures the general tendency of heavy drinking across all locations.

Socio-demographic variables

Socio demographic variables, including age and highest completed level of education, were assessed at baseline and follow-up. Highest completed level of education consisted of three categories of schooling: primary schooling (9 years); vocational training (>9–12 years); post secondary schooling (13 years or more, including high school which can be only 12 years in some Swiss cantons). Language (French, German) was only assessed at baseline.

Statistical analyses

Descriptive statistics were computed to characterize participants in terms of socio-demographics, frequency of RSOD, DVs in the 11 different locations, total DV, number of alcohol-related consequences, and number of DSM-5 AUD criteria at baseline. Correlations between frequency of RSOD, total DV, number of alcohol-related consequences, and the number of DSM-5 AUD criteria, as well as correlations between total DV and frequency of RSOD, and DVs in the 11 locations were also computed in order to understand how such variables were interrelated.

With regard to the study's first aim, correlations of DVs in the 11 locations and the frequency of RSOD, with the number of alcohol-related consequences and the number of DSM-5 AUD criteria, were computed to describe the bivariate relationships between the variables of interest at baseline. This allows to understand the raw associations between location-specific DVs and alcohol-related harm. However, as each specific location DV is part of total drinking volume, DVs in the 11 locations are assumed to share some common variance. In order to understand the unique contribution of DV in a given location, it is important to test the

associations of all drinking location simultaneously. Thus, DVs in the 11 locations were introduced in negative binomial multiple regression models predicting alcohol-related harm at baseline (model 1). Negative binomial regression models are recommended for overdispersed count variables with variances greater than their means (Long, 1997). Previous studies showed that frequency of RSOD shared some common variance with location DVs (Callinan, Livingston, Dietze, & Room, 2014; Rossow, 1996; Single & Wortley, 1993) and with alcohol-related harm (Dey, Gmel, Studer, Dermota, & Mohler-Kuo, 2014; Rossow, 1996; Single & Wortley, 1993; Wells et al., 2005; Wells et al., 2008) and thus may be a confounding variable of the association between drinking locations and harm. Thus, negative binomial multiple regression model testing the simultaneous associations of all location DVs was then adjusted for frequency of RSOD (model 2). Model 2 allows to examine the unique contribution of DV in a given location over and above that of DV in other locations and frequency of RSOD. In other words, the adjustment for RSOD was done to avoid that the location-harm link reflects just the contribution of the location to overall RSOD. Estimates therefore provide the particular contribution of the particular environment in this location over and above that of the contribution to RSOD. All models were adjusted for age, linguistic region and highest level of education.

With regard to the study's second aim, i.e. whether 15-month changes in DVs in each location were related to changes in outcomes, the first-difference method was used (Allison, 1990; Halaby, 2004) with linear regression models as differences were normally distributed. To do this, changes in the scores for all variables of interest (i.e. number of alcohol-related consequences and DSM-5 AUD criteria, the DVs in 11 locations, frequency of RSOD, and adjustment variables) were calculated by subtracting the baseline scores from the follow-up scores. Changes in RSOD and in the DVs in 11 locations were recoded into three-level

categorical variables as a function of the direction of the change between baseline and follow-up. For each location, participants who increased their DV by more than 0.5 standard drinks/week were coded as *increasers*, whereas those who decreased their alcohol intake of more than 0.5 standard drinks/week were coded as *decreasers*. Participants with a change of no more than ±0.5 standard drinks/week were coded as *no change*. For RSOD, those who reduced their frequency were coded as *decreasers*, those who increased as *increasers*, and those who did not change as *no change*. With regard to the highest level of education, those who changed to a higher level were coded as *increasers*, whereas others were coded as *no change*.

Participants who had increased or decreased their DV were first compared with those who had not changed their DV, by looking at their changes in number of alcohol-related consequences and DSM-5 AUD criteria using t-tests for independent samples. This comparison was done for DVs in each separate location, allowing to understand the raw association between change in each location DV and change in alcohol-related harm, i.e. whether change in alcohol related-harm in those who increased or decreased their alcohol consumption in a particular location differed from those who did not changed their consumption in the location. Then, two linear multiple regression models were run for each of the two change outcomes. In model 1, changes in DVs in the 11 locations were entered simultaneously, allowing to identify the contribution of DV change in a given location over that of DV changes in other locations. In model 2, change in the frequency of RSOD was entered in addition to changes in DVs in the 11 locations, allowing to examine the unique contribution of DV change in a given location to change in alcohol-related harm over and above that of change in frequency of RSOD and DV change in other locations. The *no change* category was defined as the reference for each variable. All models were adjusted for a change in age and in the highest level of education.

Before these analyses, multicollinearity was checked using the variance inflation factor (VIF) for each explanatory variable. As a rule of the thumb, VIF values greater than or equal to 5 or 10 are often considered as evidence of multicollinearity (see O'brien, 2007). No problems of multicollinearity were detected, as the highest VIF value (all VIFs < 2.01) was well below these thresholds.

Results

Descriptive characteristics of the sample

The mean age of the participants was 19.93 years (*SD* = 1.19) at baseline and 21.23 years (*SD* = 1.21) at follow-up; a little more than half were French-speaking (*n* = 2,432, 53.6%). About half reported primary schooling as their highest level of completed education (*n* = 2,230, 49.2%), whereas 27.9% (*n* = 1,268) of the sample reported vocational training, and 22.9% (*n* = 1,038) reported post-secondary schooling. Average DVs at each location, frequency of RSOD, the average number of alcohol related consequences, and the number of DSM-5 AUD criteria are reported in Table 1. More than half of the sample (50.1%) reported at least monthly RSOD. With regard to DVs by location, the three locations with the highest intake were bars/pubs, special events, and discos/nightclubs. The three locations where the intake was lowest were in cinemas/theatres, when playing sports, and at sporting events. Total weekly DV, frequency of RSOD, number of alcohol-related consequences, and number of AUD criteria, were all positively and significantly correlated. Significant positive correlations were also found between the DVs at the 11 specific locations and total weekly DV, and between the number of alcohol-related consequences and the number of AUD criteria.

Insert Table 1 about here.

Cross-sectional associations at baseline

With regard to cross-sectional associations at baseline, bivariate correlations showed that the frequency of RSOD and DVs in the 11 locations were significantly positively correlated with the number of alcohol-related consequences and the number of DSM-5 AUD criteria (see Table 1). Results of negative binomial regression models are reported in Table 2. Model 1 examined the associations of DVs in the 11 locations simultaneously; it indicated that DVs at friends' homes, bars/pubs, discos/nightclubs, outdoor public places, and special events were consistently significantly positively associated with the number of alcohol-related consequences and the number of DSM-5 AUD criteria. Furthermore, drinking at home was also significantly positively related to the number of DSM-5 AUD criteria, but not to the number of alcohol-related consequences. Model 2 controlled for frequency of RSOD; its results showed that the frequency of RSOD was significantly positively related with both outcomes. As in model 1, DVs at friends' homes, discos/nightclubs, outdoor public places, and special events remained significantly positively related to both outcomes. In contrast, DVs in bars/pubs (for consequences and AUD) and at home (for AUD) fell below the 5% significance level.

Insert Table 2 about here

Longitudinal associations

Average changes in the number of alcohol-related consequences and in the number of DSM-5 AUD criteria as a function of change in DVs in each location and of RSOD are reported in Table 3. For all locations, participants who decreased their alcohol consumption in these locations significantly decreased their numbers of alcohol-related consequences and numbers of DSM-5 AUD criteria, compared to those who reported no change in their DVs. In contrast, those who increased their alcohol consumption increased their numbers of alcohol-related consequences and numbers of DSM-5 AUD criteria significantly, compared to those who

reported no change in their DVs (although not significantly for increased DVs in cinemas/theatres).

Insert Table 3 about here

Linear regression model results of changes in DVs in the 11 locations, predicting changes in the number of alcohol-related consequences and the number of DSM-5 AUD criteria, are reported in Table 4. For a change in the number of alcohol-related consequences, the results of model 1 showed that individuals who increased their DVs in discos/nightclubs, when playing sport, and in other leisure activities reported a significantly increased number of consequences compared with those whose DVs remained stable in these locations. In contrast, those who decreased their use of alcohol at friends' homes, in bars/pubs, in discos/nightclubs, and at sporting events reported significantly decreased consequences compared with those whose DVs remained stable in these locations. In model 2, adding a change in the frequency of RSOD did not substantively change the results, i.e. significant effects of model 1 remained significant in model 2 and non-significant findings remained non-significant. Moreover, compared with *no change* in the frequency of RSOD, increasing and decreasing the frequency of RSOD were significantly related to increased and decreased numbers of consequences, respectively.

For a change in the number of DSM-5 AUD criteria, the results of model 1 showed that individuals who increased their DVs in bars/pubs and discos/nightclubs reported a significantly increased number of criteria compared with those whose DVs remained stable in these locations. In contrast, those who decreased their alcohol consumption at friends' homes, in discos/nightclubs, in other leisure activities, cinemas/theatres, and outdoor public places reported significantly decreased numbers of criteria compared with those whose DVs remained stable in these locations. When a change in the frequency of RSOD was added to the model (model 2),

results remained substantively the same as in model 1. As was true for the analyses of changes in the number of alcohol-related consequences, increasing and decreasing the frequency of RSOD was significantly related to increased and decreased numbers of DSM-5 criteria, respectively.

Insert Table 4 about here

Discussion

The present study's aims were to explore the cross-sectional and longitudinal associations of alcohol-related harm with alcohol consumption in 11 distinct drinking locations for a representative sample of Swiss young men, with and without controlling for the frequency of RSOD.

In line with previous studies conducted in Switzerland (Labhart, Graham, Wells, & Kuntsche, 2013) and the Netherlands (Knibbe, Oostveen, & Van De Goor, 1991), the highest alcohol consumption occurred in public locations, namely bars/pubs, discos/nightclubs and during special events. This finding contrasts with results of Treno and colleagues (2000) conducted in North America, showing that adults below 21 years old most frequently drank at home and at friends' homes. This discrepancy probably arises from the differences in the legal drinking age in the USA (21 years old) and Switzerland (16 years old for wine, beer and cider; 18 years old for spirits) and in their drinking cultures.

Associations with alcohol-related harm

Both cross-sectional and longitudinal analyses showed that, when tested separately, DVs in all locations were significantly positively associated with alcohol-related problems. As DV in each particular location is part of total DV, this finding is in line with previous studies showing that the total amount of alcohol consumption was positively related to experiencing alcohol-related consequences (Landberg & Hübner, 2014; Sadava, 1985). However, when DVs in all

locations and the frequency of RSOD were tested simultaneously, a different pattern of associations emerged. Drinking at home and in restaurants dropped consistently below the significance level in cross-sectional and longitudinal analyses, suggesting that, as previously shown (e.g. Casswell et al., 1993; Nyaronga et al., 2009; Stockwell et al., 1993), drinking in these locations may be less risky than drinking in other locations with regards to experiencing alcohol-related harm. This contrasts with the results of Bähler et al. (2014) who showed for clusters of locations (based on a principal component analysis) that drinking at home fell within the scope of "party" drinking (including drinking at home, in friends' homes, pubs/bars, discos/nightclubs, outdoor public places, special events), associated with experiencing more negative consequences than drinking locations falling within the "non-party" scope, including drinking at the theater/cinema, sport clubs, other clubs/societies, restaurants, and sporting events. However, this is not necessarily inconsistent with our results. Rather, this may simply indicate that among "party" drinking locations, drinking at home alone only account for weak part alcohol-related harm.

In contrast, drinking in friends' homes or at discos/nightclubs were consistently significantly related to alcohol-related harm in both cross-sectional and longitudinal analyses, even when adjusting for alcohol consumption in other locations and the frequency of RSOD. This indicates that decreasing DVs at friends' homes, and at discos/nightclubs, while holding DVs constant in other locations (i.e. decreasing total DV by decreasing DVs in such particular locations but not in others) significantly reduces alcohol-related harm compared with holding a stable consumption in these locations. This result is consistent with previous studies indicating that drinking in discos/nightclubs or at friends' homes were more strongly related to alcohol-

related problems than drinking in other locations (Bähler et al., 2014; Casswell et al., 1993; Single & Wortley, 1993; Stockwell et al., 1993; Stockwell et al., 1992; Usdan et al., 2005).

Results also suggested that drinking in outdoor public places may increase the risk of experiencing AUD-criteria, as both cross-sectional and longitudinal analyses yielded significant associations; it was true to a lesser extent for the number of alcohol related consequences, as only cross-sectional associations reached significance, although also longitudinal analysis pointed in this direction. A possible explanation of this result is that when drinking in outdoor public locations, such as a street or a park, there may typically be less supervision and fewer rules and social norms; the likelihood of meeting deviant peers may be higher than when drinking in other more supervized locations. Drinking typically takes place indoors, especially in particular settings where consumption is expected. However, drinking openly in outdoor public locations is less common and is even forbidden in many countries. Thus, drinking in the street or in parks may be indicative of the extreme and "deviant" alcohol use that is more strongly related to AUD than to negative consequences.

Taken together, these results suggest that over and above the contribution of the frequency of RSOD, alcohol consumed at specific locations such as friends' homes, discos/nightclubs, and outdoor public locations may play a role in the occurrence of alcohol-related harm. Thus, interventions targeting a decrease in alcohol consumption in these specific locations, may complement existing interventions focused on reducing the frequency of RSOD (e.g. Ziemelis, Bucknam, & Elfessi, 2002).

Several studies have also suggested that drinking in bars/pubs was particularly related to alcohol-related problems by showing that the association remained significant even when controlling for the frequency of RSOD (Bersamin et al., 2011; Casswell et al., 1993; Single &

Wortley, 1993). This finding was replicated in longitudinal analyses, but not in cross-sectional ones. This discrepancy suggests that the independent contribution to alcohol-related harm of volume drinking in bars/pubs may be less important than previously noted, when controlling for RSOD. However, as the location-specific DV in bars/pubs most strongly correlated to the frequency of RSOD, the present study's results may indicate that the contribution of drinking in such locations is at least partly confounded with that of the frequency of RSOD, which may mean that at this age drinking in bars and pubs often occurs as RSOD. This, in turn means that bars/pubs are also a target for prevention, probably more focusing on RSOD than on volume.

With regard to drinking in other locations, cross-sectional and longitudinal analyses yielded inconsistent results. Drinking during special events was significantly related to the number of alcohol-related problems in cross-sectional analyses, but not in longitudinal ones. In contrast, significant longitudinal associations were found: for drinking when playing sports (though only significant for alcohol-related consequences); during other leisure activities; at cinemas/theatres (only significant for AUD criteria); and during sporting events (only significant for alcohol-related consequences). Cross-sectional associations, however, failed to reach significance. As they were not replicated across cross-sectional and longitudinal analyses, these effects may be unreliable: they should thus be interpreted with caution. It should be noted, however that, except for special events, the locations for which inconsistent results were found were those with the lowest weekly DVs (i.e. less than weekly drinking), which may mean that increasing or decreasing consumption at low drinking levels in these occasions may not necessarily lead to more or fewer consequences. Further studies are needed to better understand the relationships between drinking in these locations and experiencing alcohol-related harm.

Limitations

The major limitation of this study is its design restricted to just two waves of questionnaires; this precluded trajectories analyses and a causal interpretation of the findings. Nevertheless, using both cross-sectional and two-wave longitudinal analyses provide more support for a causal interpretation than strict cross-sectional analyses. Moreover, the sample was limited to young adult males. To date, almost all previous studies included both genders but only three (Usdan et al., 2005; Wells et al., 2005; Wells et al., 2008) investigated whether associations between drinking locations and alcohol-related harm differed between females and males. All three studies failed to find significant gender differences. Therefore, drinking locations found to be related to alcohol-related harm in males are probably the same in females. However, further studies should include both males and females in order to test such assumption. Another limitation may be the use of a 12-month reference period for questions on alcohol use and consequences instead of shorter period, because longer reference periods are associated with higher recall bias (forgetting). However, using reference periods shorter than 12 months may also induce bias other than recall bias, such as the underestimation of the number of rare drinkers and infrequent heavy drinkers, but equally the overestimation of abstainers (Dawson & Room, 2000; Gmel & Rehm, 2004; Gmel et al., 2014). Additionally, short-term drinking would not match the reference period of consequences, for which commonly larger recall periods are used, because consequences occur despite heavy drinking relatively rarely (Dawson & Room, 2000; Gmel et al., 2014). Thus, when the objective is to examine the association between alcohol use and individual variables such as harm (e.g. number of alcohol related consequences), using shorter reference periods may lead to more pronounced bias than the recall bias introduced through longer reference periods (Gmel & Rehm, 2004; Gmel et al., 2014).

Conclusions

The present study showed that alcohol consumption in specific locations, such as at friends' homes, but also in discos/nightclubs, and in outdoor public locations, contributes significantly to predicting alcohol-related harm, even when controlling for the frequency of RSOD. Contribution of bars/pubs to harm may be also important but is mostly related to RSOD and not necessarily to volume drinking.

The study has important implications for prevention. First, there is a longitudinal association for harm from volume drinking even when adjusting for RSOD. This clearly means that not only particular heavy drinking occasions should be targeted by preventive actions, but also alcohol use in general, i.e. the volume of drinking must be additionally targeted. As alcohol-related harm occurs as well in occasions that could be supervised (e.g. bars, pubs, discos) and in probably more unsupervised locations (public places, friends' home) this calls for a general population approach of prevention, e.g. by limiting attractiveness (e.g. advertisement), availability (e.g. opening hours and densities of outlets) and affordability (e.g. prices of alcohol) of alcohol. Second, in a country where alcohol can be legally obtained at the age of 20–21 years, locations such as bars and discos, which may be less prone to harm due to legal regulations and enforcement in other countries such as the US, may need increased preventive actions. One possibility may be the enforcement of responsible beverage serving (Johnsson & Berglund, 2009; Stockwell, 2001). Third, this study suggests that there should not only be a target on reducing the overall volume of alcohol consumed and the frequency of RSOD, but that they should also specifically focus on limiting alcohol consumption in outdoor public places, discos/nightclubs, and in friends' homes, or at least on preventing harm occurring in these occasions. At least in public spaces different measures have been proposed such as Closed Circuit TV (CCTV) for

outdoor places, and even longer lists of preventive actions have been proposed for bars, pubs and discos (Graham & Homel, 2008).

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Table 1. Frequency of RSOD, location-specific DVs, and associations with total DV and alcohol-related problems (N = 4,536)

			Correlation[a]			
	N / Mean	% / Standard deviation	Total weekly drinking volumes[b]	Frequency of RSOD	Number of alcohol-related consequences	Number of DSM-5 AUD criteria
RSOD			.621*	-	.469*	.471*
Less than monthly	2,261	49.9	-	-	-	-
Monthly	1,180	26.0	-	-	-	-
More than monthly	1,095	24.1	-	-	-	-
Weekly drinking volumes[c]						
Home	1.91	5.94	.517*	.304*	.201*	.243*
Friends' homes	2.44	5.20	.705*	.467*	.371*	.410*
Bars/pubs	5.49	8.77	.830*	.545*	.391*	.409*
Discos/nightclubs	3.82	7.30	.654*	.432*	.403*	.351*
Restaurants	1.02	3.09	.546*	.323*	.234*	.250*
Playing sports	0.75	3.12	.378*	.287*	.212*	.187*
Other leisure activities	0.92	3.85	.344*	.223*	.147*	.182*
Cinemas/theatres	0.21	1.86	.286*	.231*	.196*	.189*
Sporting events	0.81	4.47	.460*	.340*	.266*	.259*
Outdoor public places	1.66	5.70	.552*	.434*	.389*	.397*
Special events	3.98	11.69	.709*	.446*	.358*	.382*
Alcohol-related harm						
Number of consequences (range 0–10)	1.53	1.88	.475*	.469*	-	.570*
Number of DSM-5 AUD (range 0–11)	1.37	1.76	.495*	.471*	-	-

Note. RSOD: risky single occasion drinking. AUD: alcohol use disorders. DSM: Diagnostic and Statistical Manual of Mental Disorders. [a]Spearman rank-order correlations. [b]reflects the sum of weekly drinking volumes at all locations. [c]in number of drinks/week. *p < .001

Table 2. Negative binomial regression models for the number of alcohol-related consequences and DSM-5 alcohol use disorder criteria on weekly drinking volumes at different locations without (model1) and with adjustment (model 2) for frequency of RSOD

	Number of alcohol-related consequences						Number of DSM-5 alcohol use disorder criteria					
	Model 1			Model 2			Model 1			Model 2		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Weekly drinking volumes												
Home	0.004	0.004	.268	0.001	0.004	.699	0.010	0.003	.004	0.006	0.003	.068
Friends' homes	0.024	0.005	<.001	0.010	0.005	.046	0.027	0.005	<.001	0.013	0.005	.009
Bars/pubs	0.016	0.003	<.001	0.003	0.003	.283	0.019	0.003	<.001	0.006	0.003	.061
Discos/nightclubs	0.026	0.004	<.001	0.018	0.003	<.001	0.016	0.004	<.001	0.009	0.003	.005
Restaurants	-0.003	0.008	.740	0.001	0.007	.860	-0.006	0.008	.433	-0.001	0.008	.878
Playing sports	0.009	0.008	.304	0.004	0.008	.658	0.015	0.008	.058	0.011	0.008	.149
Other leisure activities	-0.010	0.007	.164	-0.010	0.006	.105	-0.002	0.007	.773	-0.004	0.007	.571
Cinemas/theatres	0.016	0.016	.299	0.021	0.015	.165	0.007	0.015	.634	0.014	0.015	.342
Sporting events	0.001	0.006	.816	0.000	0.005	.928	-0.006	0.006	.280	-0.007	0.005	.220
Outdoor public places	0.022	0.004	<.001	0.012	0.004	.004	0.023	0.004	<.001	0.013	0.004	.001
Special events	0.005	0.002	.009	0.004	0.002	.017	0.005	0.002	.008	0.004	0.002	.016
RSOD (ref: less than monthly)												
Monthly				0.748	0.049	<.001				0.677	0.051	<.001
More than monthly				1.058	0.054	<.001				1.057	0.055	<.001

Note. b: regression coefficient. SE: standard error. p: p-value.

Table 3. Means (standard deviations) of differences between follow-up and baseline assessments in the number of alcohol-related consequences and the number of DSM-5 alcohol use disorder criteria as a function of change in weekly drinking volumes at each location and frequency of RSOD

	Mean (SD) change in the number of alcohol related consequences			Mean (SD) change in the number of DSM-5 alcohol use disorder criteria		
	DV Decreaser	No change DV	DV Increaser	DV Decreaser	No change DV	DV Increaser
Weekly drinking volumes						
Home	-0.30 (1.89)***	-0.08 (1.58)	0.03 (1.79)*	-0.28 (2.00)***	-0.06(1.50)	0.15 (1.86)***
Friends' homes	-0.42 (1.84)***	0.00 (1.45)	0.12 (1.81)*	-0.39 (1.89)***	0.00(1.41)	0.26 (1.81)***
Bars/pubs	-0.41 (1.86)***	-0.04 (1.42)	0.18 (1.69)***	-0.36 (1.83)***	-0.04 (1.40)	0.27 (1.74)***
Discos/nightclubs	-0.43 (1.90)***	-0.08 (1.38)	0.26 (1.75)***	-0.38 (1.84)***	0.00 (1.43)	0.28 (1.81)***
Restaurants	-0.27 (2.00)*	-0.11 (1.52)	0.10 (1.90)***	-0.22 (2.03)*	-0.06 (1.53)	0.15 (1.89)***
Playing sports	-0.33 (2.08)**	-0.11 (1.60)	0.22 (1.84)***	-0.32 (2.13)***	-0.04 (1.58)	0.21 (1.96)***
Other leisure activities	-0.35 (1.95)***	-0.09 (1.59)	0.20 (1.91)***	-0.40 (1.93)***	-0.01 (1.59)	0.17 (2.01)*
Cinemas/theatres	-0.45 (2.39)**	-0.08 (1.63)	0.03 (2.13)	-0.57 (2.57)***	-0.02 (1.60)	0.16 (2.44)
Sporting events	-0.51 (2.10)***	-0.07 (1.57)	0.18 (2.01)***	-0.31 (2.13)***	-0.03 (1.57)	0.18 (2.06)**
Outdoor public places	-0.36 (2.07)***	-0.06 (1.45)	0.09 (1.93)**	-0.41 (2.02)***	0.00 (1.41)	0.20 (2.09)**
Special events	-0.32 (1.90)***	-0.05 (1.50)	0.10 (1.77)**	-0.29 (1.87)***	-0.01 (1.46)	0.19 (1.89)***
RSOD	-0.57 (2.03)***	-0.07 (1.50)	0.35 (1.88)***	-0.60 (2.00)***	-0.01 (1.54)	0.47 (1.81)***

Note. [a]in number of standard drinks/week. RSOD: risky single occasion drinking. SD: standard deviation. *difference with *no change* is significant at $p < .05$, **difference with *no change* is significant at $p < .01$, ***difference with *no change* is significant at $p < .001$, t-test for independent samples.

Table 4. Multiple linear regression models for change (first differences) in the number of alcohol related consequences and the number of DSM-5 alcohol use disorder criteria on change in weekly drinking volumes at different locations without (model1) and with adjustment (model 2) for frequency of RSOD

	Number of alcohol related consequences						Number of DSM-5 alcohol use disorder criteria					
	Model 1			Model 2			Model 1			Model 2		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p
ΔHome[a]												
Increaser	0.036	0.064	.570	0.019	0.064	.770	0.106	0.064	.098	0.085	0.064	.182
Decreaser	0.036	0.070	.613	0.053	0.070	.452	0.035	0.071	.616	0.056	0.070	.427
ΔFriends' homes[a]												
Increaser	0.001	0.068	.992	-0.014	0.068	.833	0.117	0.068	.085	0.101	0.068	.135
Decreaser	-0.274	0.067	<.001	-0.253	0.067	<.001	-0.234	0.067	.001	-0.206	0.067	.002
ΔBars/pubs[a]												
Increaser	0.093	0.069	.177	0.066	0.069	.338	0.187	0.069	.007	0.158	0.069	.022
Decreaser	-0.168	0.070	.016	-0.142	0.070	.042	-0.127	0.070	.071	-0.093	0.070	.184
ΔDiscos/nightclubs[a]												
Increaser	0.277	0.067	<.001	0.251	0.067	<.001	0.172	0.067	.011	0.143	0.067	.033
Decreaser	-0.159	0.066	.016	-0.135	0.066	.041	-0.168	0.066	.012	-0.137	0.066	.038
ΔRestaurants[a]												
Increaser	0.059	0.070	.400	0.051	0.070	.461	0.039	0.070	.577	0.030	0.070	.665
Decreaser	0.091	0.075	.224	0.081	0.074	.278	0.114	0.075	.127	0.102	0.074	.170
ΔPlaying sports[a]												
Increaser	0.212	0.086	.014	0.227	0.086	.008	0.102	0.086	.240	0.119	0.086	.167
Decreaser	0.090	0.089	.310	0.096	0.088	.277	-0.007	0.089	.937	0.001	0.088	.995
ΔOther leisure activities[a]												
Increaser	0.168	0.082	.042	0.161	0.082	.050	0.018	0.083	.831	0.009	0.082	.916
Decreaser	-0.051	0.077	.512	-0.042	0.077	.590	-0.193	0.078	.013	-0.182	0.077	.018

Table 4. continued

	Number of alcohol related consequences						Number of DSM-5 alcohol use disorder criteria					
	Model 1			Model 2			Model 1			Model 2		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p
ΔCinemas/theatres[a]												
Increaser	-0.189	0.127	.137	-0.167	0.126	.187	-0.086	0.127	.498	-0.061	0.126	.627
Decreaser	-0.152	0.122	.213	-0.143	0.121	.240	-0.345	0.122	.005	-0.334	0.121	.006
ΔSporting events[a]												
Increaser	0.041	0.092	.654	0.038	0.091	.675	0.036	0.092	.694	0.033	0.091	.717
Decreaser	-0.273	0.090	.002	-0.273	0.090	.002	0.042	0.090	.645	0.042	0.090	.636
ΔOutdoor public places[a]												
Increaser	0.050	0.072	.491	0.040	0.072	.582	0.067	0.072	.351	0.057	0.072	.427
Decreaser	-0.088	0.069	.202	-0.066	0.069	.339	-0.230	0.069	.001	-0.202	0.069	.003
ΔSpecial events[a]												
Increaser	-0.021	0.070	.770	-0.035	0.070	.617	0.043	0.071	.542	0.027	0.070	.700
Decreaser	-0.097	0.066	.139	-0.082	0.065	.209	-0.079	0.066	.228	-0.060	0.065	.361
ΔRSOD[a]												
Increaser				0.314	0.071	<.001				0.349	0.071	<.001
Decreaser				-0.328	0.066	<.001				-0.414	0.066	<.001

Note. b: regression coefficient. SE: standard error. p: p-value. Δ: change. [a]No change as reference.