

Drinking Before Going to Licensed Premises: An Event-Level Analysis of Predrinking, Alcohol Consumption, and Adverse Outcomes

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Background: Research in the United States and the United Kingdom indicates that drinking before going out (commonly called “predrinking”) is common among young people and associated with increased harm. On the basis of Swiss data, this study investigates differences in alcohol consumption and adverse or risky outcomes for evenings when persons consumed alcohol before going to a licensed premise (i.e., predrinking), drank on-premise only, or drank off-premise only.

Methods: Using the recently developed Internet-based cell phone-optimized assessment technique (ICAT), alcohol consumption and drinking location were assessed at 6 time points (5 PM to the next morning) on Thursdays, Fridays, and Saturdays over 5 consecutive weeks by means of participants’ cell phones. Overall, 7,828 assessments provided by 183 young adults (53.0% women, mean age [SD] = 23.1 [3.1]) on 1,441 evenings were analyzed by means of cluster-adjusted means and proportion tests and of multilevel structural equation models. The extent to which alcohol consumption mediated the association between predrinking and adverse outcomes was also examined.

Results: Higher alcohol consumption occurred on evenings with predrinking (7.1 drinks on average) compared with on-premise only (4.2 drinks) and off-premise only (4.3 drinks) evenings. Adverse outcomes occurred more often on evenings with predrinking (with 23.8% of predrinking nights involving at least 1 outcome) than on evenings with on-premise drinking only (13.9%) and off-premise drinking only (12.0%). Predrinking was indirectly associated with adverse outcomes, mediated by larger amounts of alcohol consumed in the evening.

Conclusions: Because of its association with heavier consumption and related adverse outcomes, predrinking, especially combined with on-premise drinking, represents a major target for prevention. Educational interventions as well as structural measures, such as reduction in late-night off-sale opening hours, and staff training in responsible beverage service, are needed to prevent high total consumption and related adverse consequences among young people.

Key Words: Predrinking, Drinking Consequences, Event-Level, Internet-Based Cell Phone-Optimized Assessment Technique, Young Adults.

LATE-NIGHT DRINKING AND drinking in public settings have been found to be linked to harmful consequences such as accidents, injuries, victimization, and aggression among young people (Graham et al., 2002; Harford

et al., 2003; Nyaronga et al., 2009; Rossow and Hauge, 2004; Wells and Graham, 2003). Recent evidence from North America and the United Kingdom suggests that young people’s heavy drinking occasions in public settings are often preceded by “predrinking” (also known as “prepartying,” “pre-gaming,” “pre-loading,” and “frontloading”; see Borsari et al., 2007; DeJong et al., 2010; Forsyth, 2010; Pedersen and LaBrie, 2007; Wells et al., 2009; Zamboanga et al., 2011, 2010); that is, alcohol is consumed in a private dwelling (e.g., at home) or in a public place (e.g., public park) before young drinkers go to a party or drinking establishment where more alcohol may or may not be consumed (Forsyth, 2010; Pedersen and LaBrie, 2007). Predrinking typically occurs in locations with relatively low-cost alcohol and often involves rapid consumption of large quantities of alcohol (Hughes et al., 2008; Wells et al., 2009).

Previous studies found that between 65 and 75% of U.S. college students predrank in the weeks prior to the study (last 2 weeks: DeJong et al., 2010; i.e., last month: Pedersen et al., 2009) and that about 60% of U.K. pub attendees predrank on the evening of interview (Hughes et al., 2008). Those who

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predrank reported doing so 3 to 4 times per month (Kenney et al., 2010; Pedersen et al., 2009). Studies have shown that, on average, young men reported consuming 3 to 5 drinks and women 2 to 4 drinks in a predrinking session (Hammersley and Ditton, 2005; Kenney et al., 2010; Pedersen and LaBrie, 2008; Pedersen et al., 2009), and 8 drinks (men) and 6 drinks (women) over the entire evening (Pedersen and LaBrie, 2007). Predrinking has been found to be associated with consuming significantly larger amounts of alcohol over the evening. This was the case not only when comparing people who predrank with those who did not predrink (Hughes et al., 2008; Kenney et al., 2010) but also when comparing predrinking nights with non-predrinking nights for the same individuals (LaBrie and Pedersen, 2008). Predrinking has also been found to be associated with an increased risk of adverse experiences and harms such as absenteeism at school/work, blackouts, drunk driving, alcohol poisoning, and aggressive or violent acts (DeJong et al., 2010; Hughes et al., 2008; LaBrie and Pedersen, 2008; LaBrie et al., 2011; Pedersen and LaBrie, 2007; Pedersen et al., 2009).

Reasons given for predrinking include saving money (i.e., lower prices for off- vs. on-premise alcohol), getting in the mood for partying, becoming intoxicated, and socializing with friends or facilitating contacts with potential sexual partners (DeJong et al., 2010; Forsyth, 2010; Pedersen et al., 2009; Wells et al., 2009). Although predrinking to save money implies substituting predrinks for more expensive on-premise drinks, a few studies suggest that predrinking does not reduce the amount of alcohol consumed on-premise. Pedersen and LaBrie (2007) and Read and colleagues (2010) found that U.S. college students drank about one and a half times more alcohol on predrinking days compared with non-predrinking days and that about half of the total amount of alcohol was consumed after predrinking. Comparing predrinkers with non-predrinkers among U.K. pub attendees, Hughes and colleagues (2008) also observed that people who drank before a night out consumed similar amounts while out to those who did not engage in predrinking, which led her to the conclusion that prenightlife drinking is an addition rather than a substitute for nightlife drinking.

Previous studies have been conducted only in the United States and the United Kingdom and have used either retrospective or single-point assessment methods, both of which have important limitations. Retrospective assessments of 30 days and longer (e.g., Borsari et al., 2007; Kenney et al., 2010; LaBrie and Pedersen, 2008; LaBrie et al., 2011; Pedersen and LaBrie, 2007, 2008) are subject to recall bias because people's ability to recall characteristics of drinking occasions and drinks consumed on these occasions declines considerably after 2 or 3 days (Ekholm, 2004; Gmel and Rehm, 2004). Single-point face-to-face interviews conducted once a night (e.g., Forsyth, 2010; Hammersley and Ditton, 2005; Hughes et al., 2008; Reed et al., 2011) do not assess alcohol consumption and related consequences that occur after the

interview. In addition, neither of these approaches allows for an event-level investigation of linkages between predrinking, alcohol consumption and consequences. Finally, most studies have compared predrinkers with non-predrinkers rather than predrinking versus non-predrinking occasions within individuals.

In this study, we applied the recently developed Internet-based cell phone-optimized assessment technique (ICAT; Kuntsche and Labhart, in press-a) to capture consecutive snapshots of participants' alcohol consumption throughout entire evenings. More precisely, data regarding alcohol consumption and drinking locations were collected at 6 measurement points from 5 PM until 11 AM the next morning every Thursday, Friday, and Saturday over 5 consecutive weeks. Additionally, the sixth assessment, which was completed the morning following the drinking occasion, included reporting of adverse or risky outcomes experienced as a result of the previous night's drinking. This data collection method was designed to map the natural drinking history of individuals throughout entire evenings. Thus, instead of asking participants about their behavior on "predrinking occasions" (as defined by themselves), evenings were divided into sequences of events. Predrinking occasions, defined as the consumption of alcohol in a private dwelling or public place before going to commercial establishments where alcohol is served "on-premises," were identified a posteriori. Although some previous researchers have conceptualized predrinking as the consumption of alcohol before attending any public event (including sporting events, parties, as well as licensed premises), the focus of this study is drinking before going to a licensed premise. The main rationale for this focus is that licensed establishments are high-risk locations for alcohol-related harms especially among young adults. Even teenagers are at risk in Switzerland because the legal purchase age is 16 for fermented and 18 for distilled alcoholic drinks and young people of these ages are permitted to attend on-premise establishments.

The aim of this study is to investigate differences in the number of drinks consumed and adverse outcomes experienced related to predrinking evenings versus on-premise only evenings (without predrinking) and off-premise only evenings within individuals over weekend days. Because multiple evenings are recorded for the same individuals, the study design enables an event-level intra-individual analysis, with participants serving as their own controls. Two specific hypotheses will be tested:

1. that higher overall alcohol consumption will occur on predrinking evenings than on on-premise only evenings, with no difference in total on-premise consumption on predrinking versus non-predrinking evenings;
2. that more adverse or risky outcomes will occur related to predrinking evenings than to on-premise only and off-premise only evenings, with this relationship mediated by greater alcohol consumption on predrinking evenings.

MATERIALS AND METHODS

Study Design and Procedures

The data collection was conducted using the recently developed ICAT (Kuntsche and Labhart, in press-a). This data collection technique consists of a baseline internet questionnaire completed by participants on their own computers after online registration and a series of Internet-based questionnaires completed on participants' personal cell phones. Participants were recruited from 3 higher education institutions in the 2 major cities in the French-speaking part of Switzerland: the Lausanne Hotel School (approximately 1,200 undergraduate and graduate students), the Apprenticeship school in Lausanne (approximately 500 undergraduate students), and the University of Applied Sciences in Geneva (approximately 3,500 undergraduate and graduate students). Students at each institution were sent an invitation by email by the institutions' administrators, which included a hyperlink to the study's registration webpage. The email and webpage provided the following information: the aim of the study (i.e., to gather data on alcohol use in the evening over 5 consecutive weekends by means of the participants' cell phones); that answers were voluntary and would be treated as confidential; that those who returned at least 80% of the cell phone questionnaires would be entered into a prize draw for cinema tickets or bookstore vouchers with a monetary value ranging from 40 to 80 USD; and contact details. After volunteers have entered their cell phone number at the bottom of the webpage, they received a unique validation code in an SMS message (Short Message Service) they had to enter online again to validate their cell phone number. Subsequently, participants were automatically redirected to the baseline Internet questionnaire which contained questions such as age, sex, usual alcohol consumption per day, frequency of heavy episodic drinking, drinking motives (10 items in total), and took about 6 to 7 minutes to complete.

Data collection by cell phone started on the first or second Thursday after registration and continued for 5 weeks. Every Thursday, Friday, and Saturday evening, participants were sent 6 text messages (SMS; at 8, 9, 10, 11 PM, midnight, and the next morning at 11 AM) containing a hyperlink for completing a brief questionnaire using their cell phone browser. Each questionnaire included questions about the amount of alcohol consumed and location of consumption during the preceding hour (except for the 8 PM questionnaire which covered the period from 5 to 8 PM and the next morning questionnaire which referred to events since midnight). To facilitate completing the questionnaires in a routine-like way, all questionnaires contained the same questions, in the same order, and answer categories were provided in easy-to-use drop-down menus. This was carried out to help participants complete the questionnaire correctly even in difficult situations such as when inebriated. To minimize recall bias, responses were only accepted within a 12-hour period following the end of the time frame to be recorded. Overall, 50% of the questionnaires were submitted within 15 minutes of receiving the text message, 70% within 1 hour, and 90% within 4 hours. Completion of each cell phone questionnaire took <1 minute.

The study was conducted between April and July 2010 and approved by the Research Ethics Board of Lausanne University (Canton de Vaud Protocol No. 223/08).

Sample

During the 1-week recruitment period, 276 participants registered and completed the baseline questionnaire. Of these, 24 (8.7%) were excluded because they did not participate in the cell phone data collection. The remaining 252 participants submitted 10,353 assessments over a total of 2,412 participant-evenings. To ensure sufficient information about drinking over the course of each evening, evenings with more than one missing assessment before mid-

night were removed. This resulted in the exclusion of 2,286 assessments (22.1%), 971 evenings (40.3%), and 53 participants (21.0%). In addition, 16 participants (8.0%) who reported no alcohol consumption during the entire cell phone data collection were excluded. The final sample comprised 183 participants (97 women [53.0%], mean age = 23.1 [SD = 3.1]), who submitted 7,828 assessments over 1,441 evenings. For the 818 missing assessments (9.5%) for these evenings, data were imputed by means of chained equations using the Stata ICE procedure (Royston, 2005).

The 69 excluded participants were similar to those in the final sample in terms of gender (55.1% women; chi-square = 0.09; $p = 0.769$), and alcohol consumption per usual occasion (mean = 3.5 drinks [SD = 2.5] vs. 3.4 [SD = 1.8]; $t = 0.49$; $p = 0.623$), but were slightly younger (mean = 22.1 [SD = 3.3]; $t = -2.29$; $p = 0.023$). For more detailed information about the ICAT procedure, see Kuntsche and Labhart (in press-b).

Measures

Gender and Age. Gender and age were recorded in the baseline Internet questionnaire.

Alcohol Consumption. Each cell phone assessment asked: "How many of the following alcoholic drinks did you have between...?" (relevant time frame: 5 to 8, 8 to 9, 9 to 10, 10 to 11, 11 PM-midnight, and after midnight): "beer," "wine and champagne," "aperitifs and liqueurs," "spirits," "cocktails and self-mixed beverages (e.g., whiskey-coke)," and "premixed alcopops." Response options were "0," "1," "2," "3," "4," and "5 or more" (coded as 5.5). A standard drink was defined as 10 g of pure ethanol. These were summed to calculate the number of drinks consumed in the given time frame.

Heavy Episodic Drinking. Heavy episodic drinking was defined as the consumption of at least 4 drinks for women and 5 drinks for men in accordance with common cutoffs used in studies of young adults (Wechsler and Nelson, 2001). Heavy episodic drinking was measured for the overall evening as well as during the predrinking time period, if applicable.

Off-Premise Only, On-Premise Only, and Predrinking Evenings. For the first 5 assessments taken up to midnight, participants were asked how much time they spent at the following locations: "at a home," "traveling (bus, car, on foot)," "outdoors (public park or natural setting)," "at work, in class," "in a restaurant, pub or nightclub," or "in a cultural or sporting venue (cinema, stadium, etc.," within the above-mentioned time frames. Answer categories were structured in half hour increments ("0," "30," "60," up to "180" minutes) for the 5 to 8 PM assessment and in quarter hour increments ("0," "15," up to "60" minutes) for the 4 following 1-hour assessments. For the analyses, 2 categories of evenings were defined according to the locations visited during the entire evening. Evenings were coded as (i) *on-premise* if the participant attended any on-premise location (i.e., restaurants, pubs or nightclubs, and cultural or sporting venues) at least for a short period of time and even if no alcohol was consumed; (ii) *off-premise only* if the participant did not report any on-premise attendance. In addition, each on-premise evening was coded dichotomously depending on whether or not the participant engaged in *predrinking*, which was defined as the consumption of at least 1 drink in an off-premise location (e.g., at home, traveling, outdoors) before spending time on-premise. The 3 types of evenings (i.e., on-premise with predrinking, on-premise only, and off-premise only) were used in subsequent comparisons.

Six *adverse or risky outcomes* from the previous night's drinking were recorded as part of the 11 AM assessment. Participants were asked whether any of the following occurred as a result of their drinking during the previous evening: hangover, injured self or

someone else, black-out (not remember what happened), unplanned use of other substances, unintended or unprotected sexual intercourse, and property damage or vandalism. The selection of outcomes was derived from the Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2005). Owing to severe space constraints in the cell phone questionnaire, we selected only concrete outcomes that were likely to be commonly experienced even with relatively low levels of alcohol consumption and would be attributed to drinking. Responses to the 6 outcomes were summed to obtain a score ranging from 0 to 6.

Statistical Analysis

t-Tests and chi-square tests were used to compare the number of drinks consumed, the proportion of participants engaging in heavy episodic drinking, the number of adverse or risky outcomes from drinking and the proportion of participants experiencing at least 1 outcome on evenings involving predrinking compared with evenings where drinking occurred entirely off-premise or entirely on-premise, with participants serving as their own controls. Standard errors of mean and proportion tests were adjusted to account for the design effect of evenings being nested within individuals using the software STATA 11 (StataCorp LP, 2009).

To investigate multivariate relationships between predrinking, the number of drinks consumed and adverse outcomes from drinking, a multilevel structural equation model was estimated using the software Mplus 6.1 (Muthén and Muthén, 2010). Gender and age were included at the individual level. Evening-level variables included day of the week (Thursday, Friday, Saturday; reference group = Thursday), predrinking, and on-premise only attendance. Predrinking evenings were distinguished from the on-premise only evenings to estimate the effect of both situations independently (reference group = off-premise only evening). We also assessed indirect effects of predrinking and on-premise attendance on adverse or risky outcomes from drinking via the number of drinks consumed. Reported effect sizes were unstandardized regression coefficients (*B*) and explained variance (*R*²).

RESULTS

As shown in Fig. 1, 689 evenings involved on-premise attendance and 752 involved no on-premise attendance (coded as “off-premise only”). Alcohol was consumed on 512 evenings (74.3%) involving on-premise attendance and 349 (46.4%) involving no on-premise attendance. Of evenings involving alcohol use and on-premise attendance, 189 involved predrinking. In terms of drinking location, 42.1% of evenings involved drinking at home for at least some of the evening, 10.5% drinking outdoors or traveling, 6.1% drinking at work or in class, 27.8% drinking in a restaurant, pub or nightclub, and 6.0% drinking in a cultural or sporting venue.

Of the 183 participants, 59.6% reported predrinking at least once, 15.8% predrinking twice, and 9.8% predrinking on 3 or more occasions during the study. Most of participants (85.8%) drank on-premise at least once, with 19.7% doing so only once during the study, 42.6% on 2 to 4 evenings, and 23.5% on 5 or more evenings. Across all evenings, 78.1% of participants reported heavy episodic drinking (76.7% of men and 79.4% of women) on at least 1 evening. In terms of adverse or risky outcomes from drinking, the following are the 47.5% of men and women in the study report-

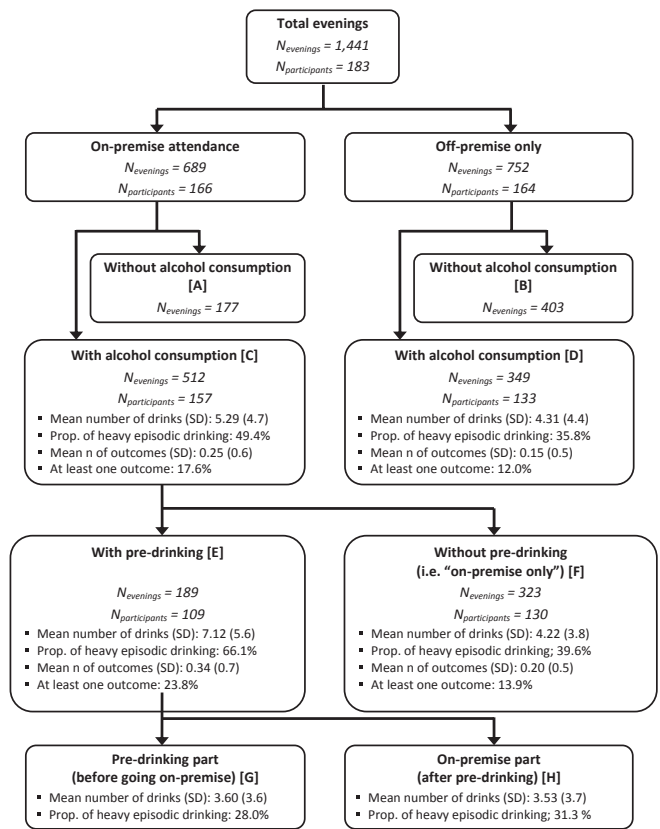


Fig. 1. Classification of evenings according to the location, the total alcohol consumption, and the adverse or risky outcomes.

ing each type of outcome: hangover (40.7% men, 36.1% women), unplanned substance use (20.9% and 12.4%), blackouts (11.6% and 7.2%), unintended or unprotected sexual intercourse (8.1% and 5.2%), injured self or someone else (5.8% and 3.1%), and property damage or vandalism (3.5% and 0.0%).

As shown Fig. 1, participants drank about 1 standard drink more and experienced slightly more adverse or risky outcomes during on-premise evenings (with and without predrinking) compared with off-premise only evenings, although these differences were not significant (see also Table 1). The number of drinks consumed on evenings with predrinking (mean = 7.12 drinks) was significantly higher compared with on-premise only evenings (4.22 drinks) and off-premise only evenings (4.31 drinks). Although the amounts consumed while predrinking (3.60 drinks) and on-premise following predrinking (3.53 drinks) were slightly lower than those amounts consumed on off-premise only evenings (4.31 drinks) and on-premise only evenings (4.22 drinks), respectively, these differences were not significant. Heavy episodic drinking (5 or more drinks for men; 4 or more drinks for women) occurred on 66.1% of evenings with predrinking versus 39.6% of on-premise only and 35.6% of off-premise only evenings. Furthermore, heavy episodic drinking occurred 28.0% of predrinking sessions (before going on-premise) and in 31.1% of on-premise sessions following

Table 1. Mean Number of Drinks and Adverse or Risky Outcomes from Drinking and Proportion of People Experiencing an Outcome

	Number of drinks				Proportion of heavy episodic drinking ^a				Number of adverse or risky outcomes				Experienced at least 1 outcome			
	Mean	F ^b	df	p	%	F ^c	df	p	Mean	F ^b	df	p	%	F ^c	df	p
Evening patterns																
On-premise drinking [C] vs. off-premise drinking [D]	5.29 4.31	6.77	181	0.010	49.4 35.8	13.99	181	0.000	0.25 0.15	5.46	181	0.020	17.6 12.0	4.51	181	0.035
On-premise with predrinking [E] vs. on-premise without predrinking [F]	7.12 4.22	44.53	156	0.000	66.1 39.6	37.83	156	0.000	0.34 0.20	6.30	156	0.013	23.8 13.9	6.48	156	0.012
On-premise without predrinking [F] vs. off-premise drinking [D]	4.22 4.31	0.06	167	0.801	39.6 35.8	0.92	167	0.340	0.20 0.15	0.86	167	0.356	13.9 12.0	0.53	167	0.516
On-premise with predrinking [E] vs. off-premise drinking [D]	7.12 4.31	32.63	161	0.000	66.1 35.8	47.56	161	0.000	0.34 0.15	10.24	161	0.002	23.8 12.0	12.77	161	0.001
Predrinking [G] vs. off-premise drinking only [D] ^d	3.60 4.31	3.76	108	0.055	28.0 35.8	1.65	108	0.202								
On-premise after predrinking [H] vs. on-premise without predrinking [F] ^d	3.53 4.22	1.28	108	0.261	31.1 39.6	4.97	108	0.028								

^aConsumption of at least 4/5 drinks for women/men during the evening or, if applicable, during predrinking session and after predrinking session.

^bAdjusted *t*-test for the design effect of cluster on individuals.

^cAdjusted chi-square test for the design effect of cluster on individuals.

^dTest performed on the 109 participants who engaged in predrinking at least once during the study.

[‘X’] refers to the letters in the frames in Fig. 1.

predrinking; in 8.5% of predrinking evenings, the participant engaged in heavy episodic drinking in both sessions.

Participants experienced significantly more adverse or risky outcomes and were significantly more likely to experience these outcomes on predrinking evenings than when drinking was done on-premise only or off-premise only (Table 1). Differences in outcomes for on-premise versus off-premise only evenings were not significant.

To investigate the joint impact of different evening characteristics (predrinking, on-premise attendance, and day of week) and the mediating role of alcohol consumption, a multilevel structural equation model was estimated. As shown in Fig. 2, number of drinks consumed was significantly higher on predrinking and on-premise evenings without predrinking (vs. off-premise evenings), on Friday and Saturday nights (vs. Thursday nights) and among men. Number of adverse or risky outcomes was significantly associated with number of drinks consumed. We also found significant *direct* effects of Saturday night and male gender on adverse or risky outcomes, as well as significant *indirect* effects of predrinking (increase in 0.19) and on-premise drinking (increase in 0.04) via an increase in the total number of drinks consumed in the evenings.

DISCUSSION

Despite differences in drinking culture (French-speaking Switzerland is a wine-producing area where drinking is relatively common), data collection methods, and alcohol policy (legal purchase age in Switzerland is 16 for fermented alcoholic drinks), this study corroborates previous findings from

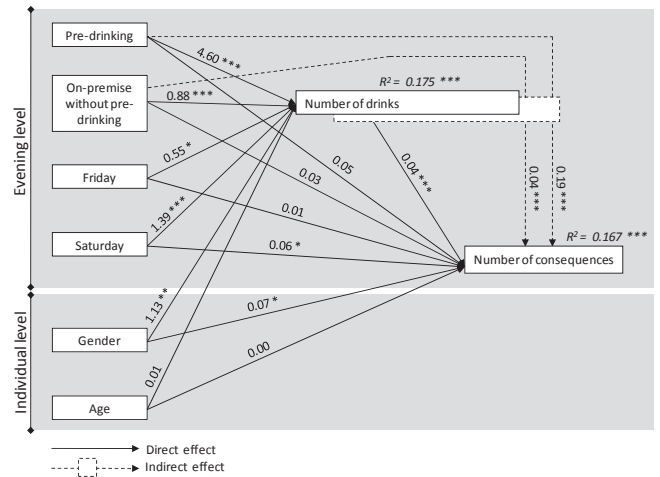


Fig. 2. Direct and indirect effects of participants’ and evening characteristics on number of drinks and adverse and risky outcomes from drinking (B estimate and level of significance). **p* < 0.05, ***p* < 0.01, ****p* < 0.001; predrinking evenings were distinguished from the on-premise only evenings to estimate the effect of both situations independently.

research in North America and the United Kingdom that predrinking is common among young people and is associated with heavy drinking. We found a slightly lower proportion of respondents who reported predrinking (59.6%) compared with findings from previous research (DeJong et al., 2010; Hughes et al., 2008; Pedersen et al., 2009). However, similar results were found for higher alcohol consumption on predrinking versus non-predrinking evenings, that is, about 4 drinks without predrinking and 7 with predrinking (Hughes et al., 2008; Kenney et al., 2010; LaBrie and Peder-

sen, 2008; Reed et al., 2011). In addition, given the large proportion of evenings involving heavy episodic drinking, results of the present study are consistent with the young adult “heavy weekend drinking culture” previously reported in Switzerland (Gmel et al., 2008; Heeb et al., 2008; Kuntsche and Cooper, 2010).

Using event-level intra-individual analysis, our study extends previous findings by ensuring that differences are not simply related to the type of people who predrink. The results show that alcohol consumption was almost twice as high on predrinking evenings as on either off- or on-premise only evenings. This confirms our first hypothesis and supports previous research indicating that predrinking adds to the total amount of alcohol consumed in the evening, rather than substituting for and reducing the amount subsequently consumed on-premise (Hughes et al., 2008; Pedersen and LaBrie, 2007; Read et al., 2010). Thus, while young people may engage in predrinking with the goal of saving money, they may end up consuming and spending more than planned while on-premise. Alternatively, if the main motive is heightened intoxication (Reed et al., 2011; Room and Livingston, 2009), predrinking may be a cheap way of becoming intoxicated before going out, but does not preclude further drinking. Moreover, results showed that heavy episodic drinking was found not only in about one-fourth of predrinking sessions (28%) but also in about one-third (31%) of the drinking sessions following predrinking. Such findings suggest that a sizable proportion of young adults make their way both to and from bars and nightclubs in a state of intoxication.

The present article also adds new knowledge about the nature of the link between predrinking and adverse outcomes through an examination of the mediating effect of alcohol consumption. Confirming our second hypothesis, results showed that predrinking was associated with more adverse or risky outcomes but only *indirectly*, mediated by greater amounts of alcohol consumed on predrinking evenings. This finding suggests that predrinking is linked to adverse or risky outcomes because of its impact on increased consumption.

A number of limitations should be acknowledged. First, a nonrandom sample was used which may not be representative of all young adults in French-speaking Switzerland; however, to minimize possible selection bias, participants were recruited from 3 different types of higher education schools and in 2 different cities. Second, the ICAT data collection approach required that participants connected their cell phones to the Internet, which may have prevented some people from participating. However, use of the Internet on cell phones is very common in Switzerland and other European countries, particularly among young adults (Kuntsche and Labhart, in press-c). Third, the frequency of assessments and the small size of cell phone screens limited the content of each questionnaire assessment making it necessary to use brief questions instead more comprehensive and extensive instruments. Given that it was necessary to keep the survey brief, only a small number of commonly experienced adverse

and risky outcomes from drinking could be assessed. The results do not address more serious harms (e.g., partner abuse, sexual assault, and homicide) because these were unlikely to occur within the time frame (5 weeks) of the present study given that they are rare events. An additional limitation is that, after a couple of drinks, participants may have had difficulty remembering exactly how many drinks they had consumed during the previous time period. Using short time frames (i.e., mostly 60 minutes) and multiple assessments, however, we minimized potential recall bias. On the other hand, a potential downside to frequent assessments might be assessment reactivity, in that participants may change their drinking behavior owing to the perception that their behavior is being monitored. To minimize potential assessment reactivity, questionnaires were designed to be completed in <1 minute and become part of a daily routine (Kuntsche and Labhart, in press-a). Further research is nevertheless needed to assess how such frequent assessments impact sample selection, retention rate and reactivity within a cell phone-based assessment technique. Another possible limitation is that it was possible to complete more than 1 assessment for a particular evening at one time, because of the requirement that each assessment be completed within a 12-hour period, possibly resulting in inaccurate data. However, our results indicated that most of all assessments (70%) were completed within 1 hour after the time period of study. Moreover, the recall period of 12 hours is much less than in most studies on alcohol consumption.

Among the strengths of the study is the convenience and accuracy of measurement using cell phones, the ability to tease apart effects of predrinking and on-premise drinking and the ability to conduct intra-individual analyses. Moreover, based on the information of the participants' location at a given time, it was possible to identify predrinking evenings a posteriori. This approach has the advantage of objectively considering all evenings with off-premise drinking followed by on-premise attendance as predrinking rather than just those subjectively defined by participants as intentional “predrinking,” which may be more likely to involve planned intoxication. Further research is needed to better understand the relative effects of “intentional predrinking” versus “happening to drink before going out” by comparing self-defined “predrinking” with the present a posteriori coding approach. Additional research is also needed to better understand other forms of predrinking, such as drinking in a pub prior to attending a nightclub or drinking at home prior to attending a party. Thus, although the present results cannot determine whether predrinking led accidentally to heavier consumption or was part of a planned strategy to drink more on particular evenings, the link between predrinking and heavy episodic drinking is evident and should represent a major target for prevention.

Overall, by applying a longitudinal methodology (i.e., following the same individuals across multiple evenings) and using an event-level intra-individual analysis, the present study extended previous findings based on retrospective or

single-point methods. Our results suggest that across the 1,441 different evenings recorded, predrinking combined with on-premise drinking was associated with heavier consumption and consequently greater risk of adverse or risky outcomes than other types of evenings. These findings have important implications for addressing drinking and related problems among young adults in Switzerland. In particular, structural measures may be needed to reduce high total consumption and related adverse or risky outcomes resulting from combining predrinking with on-premise drinking. This includes, for example, reduction in late-night off-sale opening hours, as well as restriction of drinking in public places and access to on-premise establishments once intoxicated. Staff training to detect inebriated patrons before they enter the premises and to ensure responsible beverage service might also contribute to prevent intoxication among those who have engaged in predrinking. Finally, given that predrinking is associated with heavier consumption and more adverse or risky outcomes from drinking, regardless of whether the intention was to get drunk, educational interventions that aim to inform young adults of the risks related to predrinking and heavy episodic drinking should be considered.

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REFERENCES

- Borsari B, Boyle KE, Hustad JTP, Barnett NP, O'Leary Tevyaw T, Kahler CW (2007) Drinking before drinking: pregaming and drinking games in mandated students. *Addict Behav* 32:2694–2705.
- DeJong W, DeRicco B, Schneider SK (2010) Pregaming: an exploratory study of strategic drinking by college students in Pennsylvania. *J Am Coll Health* 58:307–316.
- Ekholm O (2004) Influence of the recall period on self-reported alcohol intake. *Eur J Clin Nutr* 58:60–63.
- Forsyth AJM (2010) Front, side, and back-loading: patrons' rationales for consuming alcohol purchased off-premises before, during, or after attending nightclubs. *J Subst Use* 15:31–41.
- Gmel G, Gaume J, Faouzi M, Kulling J-P, Daepfen J-B (2008) Who drinks most of the total alcohol in young men — risky single occasion drinking as normative behaviour. *Alcohol Alcohol* 43:692–697.
- Gmel G, Rehm J (2004) Measuring alcohol consumption. *Contemp Drug Probl* 31(Fall):467–540.
- Graham K, Wells S, Jelley J (2002) The social context of physical aggression among adults. *J Interpers Violence* 17:64–83.
- Hammersley R, Dittton J (2005) Binge or bout? Quantity and rate of drinking by young people in the evening in licensed premises. *Drugs Educ Prev Policy* 12:493–500.
- Harford TC, Wechsler H, Muthén BO (2003) Alcohol-related aggression and drinking at off-campus parties and bars: a national study of current drinkers in college. *J Stud Alcohol* 64:704–711.
- Heeb J-L, Gmel G, Rehm J, Mohler-Kuo M (2008) Exploring daily variations of drinking in the Swiss general population. A growth curve analysis. *Int J Methods Psychiatr Res* 17:1–11.
- Hughes K, Anderson Z, Morleo M, Bellis MA (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.
- Kahler CW, Strong DR, Read JP (2005) Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: the brief young adult alcohol consequences questionnaire. *Alcohol Clin Exp Res* 29:1180–1189.
- Kenney SR, Hummer JF, LaBrie JW (2010) An examination of prepartying and drinking game playing during high school and their impact on alcohol-related risk upon entrance into college. *J Youth Adolesc* 39:999–1011.
- Kuntsche E, Cooper ML (2010) Drinking to have fun and to get drunk: motives as predictors of weekend drinking over and above usual drinking habits. *Drug Alcohol Depend* 110:259–262.
- Kuntsche E, Labhart F (in press-a) ICAT: development of an internet-based data collection method for ecological momentary assessment using personal cell phones. *Eur J Psychol Assess*.
- Kuntsche E, Labhart F (in press-b) Investigating the drinking patterns of young people over the course of the evening at weekends. *Drug Alcohol Depend*.
- Kuntsche E, Labhart F (in press-c) Using personal cell phones for ecological momentary assessment—an overview of current developments. *Eur Psychol*.
- LaBrie JW, Hummer J, Kenney S, Lac A, Pedersen E (2011) Identifying factors that increase the likelihood for alcohol-induced blackouts in the prepartying context. *Subst Use Misuse* 46:992–1002.
- LaBrie JW, Pedersen ER (2008) Prepartying promotes heightened risk in the college environment: an event-level report. *Addict Behav* 33:955–959.
- Muthén LK, Muthén BO (2010) *Mplus: User's Guide*. Muthén & Muthén, Los Angeles.
- Nyaronga D, Greenfield TK, McDaniel PA (2009) Drinking context and drinking problems among black, white and Hispanic men and women in the 1984, 1995, and 2005 U.S. National Alcohol Surveys. *J Stud Alcohol Drugs* 70:16–26.
- Pedersen ER, LaBrie JW (2007) Partying before the party: examining prepartying behavior among college students. *J Am Coll Health* 56:237–245.
- Pedersen ER, LaBrie JW (2008) Normative misperceptions of drinking among college students: a look at the specific contexts of prepartying and drinking games. *J Stud Alcohol Drugs* 69:406–411.
- Pedersen ER, LaBrie JW, Kilmer J (2009) Before you slip into the night, you'll want something to drink: exploring the reasons for prepartying behavior among college student drinkers. *Issues Ment Health Nurs* 30:354–363.
- Read JP, Merrill JE, Bytschkow K (2010) Before the party starts: risk factors and reasons for “pregaming” in college students. *J Am Coll Health* 58:461–472.
- Reed MB, Clapp JD, Weber M, Trim R, Lange J, Shillington AM (2011) Predictors of partying prior to bar attendance and subsequent BrAC. *Addict Behav* 36:1341–1343.
- Room R, Livingston M (2009) Does it matter where the drinking is, when the object is getting drunk? *Addiction* 104:10–11; discussion 11–12.
- Rossov I, Hauge R (2004) Who pays for the drinking? Characteristics of the extent and distribution of social harms from others' drinking. *Addiction* 99:1094–1102.
- Royston P (2005) Multiple imputation of missing values: update. *Stata J* 5:1–14.

- StataCorp LP (2009) Stata: Release 11. Statistical Software. Stata Press, College Station, TX.
- Wechsler H, Nelson TF (2001) Binge drinking and the American college student: what's five drinks? *Psychol Addict Behav* 15:287–291.
- Wells S, Graham K (2003) Aggression involving alcohol: relationship to drinking patterns and social context. *Addiction* 98:33–42.
- 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.
- Zamboanga BL, Borsari B, Ham LS, Olthuis JV, Van Tyne K, Casner HG (2011) Pregaming in high school students: relevance to risky drinking practices, alcohol cognitions, and the social drinking context. *Psychol Addict Behav* 25:340–345.
- Zamboanga BL, Schwartz SJ, Ham LS, Borsari B, Van Tyne K (2010) Alcohol expectancies, pre-gaming, drinking games, and hazardous alcohol use in a multiethnic sample of college students. *Cognit Ther Res* 34:124–133.