Published in final edited form as:

Subst Use Misuse. 2014 December ; 49(14): 1878–1887. doi:10.3109/10826084.2014.913630.

Indicators of Club Management Practices and Biological Measurements of Patrons' Drug and Alcohol Use

Hilary F. Byrnes,

Prevention Research Center, Pacific Institute for Research and Evaluation, Berkeley, CA

Brenda A. Miller,

Prevention Research Center, Pacific Institute for Research and Evaluation, Berkeley, CA

Mark B. Johnson, and

Pacific Institute for Research and Evaluation, Calverton, MD

Robert B. Voas

Pacific Institute for Research and Evaluation, Calverton, MD

Abstract

Background—Electronic Music Dance Events in nightclubs attract patrons with heavy alcohol/drug use. Public health concerns are raised from risks related to these behaviors. Practices associated with increased risk in these club settings need to be identified.

Objectives—The relationship between club management practices and biological measures of patrons' alcohol/drug use is examined.

Methods—Observational data from 25 events across 6 urban clubs were integrated with survey data (N=738 patrons, 42.8% female) from patrons exiting these events, 2010–2012. Five indicators of club management practices were examined using mixed model regressions: club security, bar crowding, safety signs, serving intoxicated patrons, and isolation.

Results—Analyses revealed that serving intoxicated patrons and safety signs were related to less substance use. Specifically, serving intoxicated patrons was related to heavy alcohol and drug use at exit, while safety signs were marginally related to less exit drug use.

Conclusions/Importance—Findings indicate observable measures in nightclubs provide important indicators for alcohol/drug use, suggesting practices to target. Study strengths include the use of biological measures of substance use on a relatively large scale. Limitations and future directions are discussed.

Keywords

nightclubs; alcohol use; drug use; young adults; club management practices

Correspondence concerning this article should be addressed to Hilary F. Byrnes, Prevention Research Center, 1995 University Ave., Suite 450, Berkeley, CA 94704. hbyrnes@prev.org.

Declaration of Interest

The authors report no conflicts of interest.

Risk Behavior at Electronic Music and Dance Events (EMDEs)

The electronic music and dance event (EMDE) is a popular type of nightclub entertainment for young adults (Miller, Byrnes, Branner, Voas, & Johnson, 2013; Miller, Furr-Holden, Voas, & Bright, 2005; Miller et al., 2009) that offers electronic, instead of live, music, and encourages dancing through music and dance space. EMDEs, which typically take place at bars or clubs, attract emerging adults who may be engaging in risky behaviors. Drug and alcohol use have long been associated with club patrons, with earlier studies relying on self-report (Arria, Yacoubian, Fost, & Wish, 2002; Degenhardt, Dillon, Duff, & Ross, 2006; Kurtz, Surratt, Levi-Minzi, & Mooss, 2011; Ramo, Grov, Delucchi, Kelly, & Parsons, 2010).

More recently, studies have begun to use biological measurements of drug and alcohol use (Furr-Holden, Voas, Kelley-Baker, & Miller, 2006; Miller, Byrnes, Branner, Johnson, & Voas, 2013; Miller et al., 2005; Miller et al., 2009). Biological assessments typically identify higher rates of recent drug use than self-reports (Gripenberg-Abdon et al., 2012; Johnson, Voas, Miller, & Holder, 2009). Studies using biological measurements show frequent drug and heavy alcohol use among club patrons (Miller, Byrnes, Branner, Johnson, et al., 2013; Miller, Byrnes, Branner, Voas, et al., 2013; Miller et al., 2005; Miller et al., 2009). At exit, 71.3% of individuals had consumed alcohol and 44.9% were impaired or intoxicated (Miller, Byrnes, Branner, Voas, et al., 2013). One quarter of patrons were positive for drug use at exit, with 18.4% using both drugs and alcohol. Clubs also attract patrons that have already used alcohol and drugs prior to coming to the club. For example, 53.9% of patrons arrived having already drank alcohol and 13.3% were legally intoxicated (BAC $\geq$ 0.08%) at entrance. One-fifth of club patrons were positive for drug use at entrance. This phenomenon of clubs, heavy alcohol use, and drug use has been replicated in international studies (Barrett, Gross, Garand, & Pihl, 2005; Chinet, Stephan, Zobel, & Halfon, 2007)

Due to high rates of heavy drinking and drug use at clubs featuring EMDEs, public health concerns are raised related to risks from these behaviors. For example, riding or driving with an intoxicated or drugged driver (Johnson, Voas, & Miller, 2012; Voas, Johnson, & Miller, 2013), alcohol intoxication (Miller, Byrnes, Branner, Johnson, et al., 2013; Miller et al., 2009), and physical and sexual aggression are also of concern. Therefore, factors related to increased risk in these club settings need to be identified.

Club Management Practices: Relationships to Patron Risk Behavior

An ecological perspective (McLeroy et al., 1988; Stokols, 1996) is relevant for understanding influences of nightlife venues on drinking and drug use. Research in health promotion has become more ecological in orientation over recent years due to the complexity of public health challenges, which often require understanding across multiple levels (Stokols, 1996). The social ecological perspective on health promotion (McLeroy et al 1988) is an interdisciplinary paradigm emphasizing the multiple aspects of environmental settings that influence health (Stokols 1996). These different aspects, such as physical, social, and cultural, interact with each other and personal factors to affect health. Stemming from this ecological perspective, Clapp et al's (2009) Ecological Model of Alcohol Use and

Problems in bars may also provide insight. In this model, characteristics of the bar/club environment and the person have reciprocal influences, and in turn, both affect drinking and related outcomes. Individual and environmental characteristics may also interact to predict drinking outcomes. As drinking increases, related problems (e.g., violence) would also be expected to increase. Certain environmental features may also moderate the likelihood of drinking and related problems.

As a result of different club management practices, clubs may provide environmental conditions that adversely affect patron health and encourage or allow risk taking behaviors. Clubs may allow for this through either unintentionally neglectful management practices or conscious management styles that permit excessive behaviors (e.g., over-serving, encouraging drinking). Indicators of management practices, such as over-serving and crowding, may signal that risk behavior is tolerated. Indicators of management practices are proxies for management decisions, and are indicators of how the decisions were implemented by staff. For example, club security reflects policies about security staffing and procedures, bar crowding is reflective of the number of patrons a club allows to enter, and the presence of isolated areas reflect decisions about the design and use of space in the club. Posting of safety signs indicates communication with staff about management safety decisions, and may be a response to problem behavior in the past, or an attempt to prevent problems from occurring. Serving intoxicated patrons may reflect training and enforcement regarding club policies.

Several indicators of bar/club management practices that have been reported from observational studies have been empirically associated with these risk behaviors (Graham, Bernards, Osgood, & Wells, 2012; Green & Plant, 2007; Hughes et al., 2011). Prior studies have found security practices to be strongly related to violence and disorder (e.g., rowdy behavior) in bars (Graham, Bernards, Osgood, & Wells, 2006; Graham et al., 2012; Homel, Carvolth, Hauritz, McIlwain, & Teague, 2004; Roberts, 2007; Wells, Graham, & Tremblay, 2009). However, the relation of security practices to patron's heavy drinking or drug use has not been examined, although these may be important indicators for substance use.

Bar crowding reflects club management policies and practices and overcrowding makes for more difficult environments to regulate. Bar crowding has been found to be important for risk behavior in bars, although most studies have focused on its impact on aggression, rather than on heavy alcohol or drug use (Green & Plant, 2007; Leonard, Collins, & Quigley, 2003; Leonard, Quigley, & Collins, 2003). The few studies examining the influence of bar crowding on heavy alcohol use found that more crowded venues and dance floors were related to increased alcohol use and intoxication (Graham, 1985; Hughes et al., 2011). The relationship of crowding with drug use has not been determined.

Although most states prohibit serving alcohol to intoxicated patrons, the practice is common (Clapp et al., 2009; Green & Plant, 2007). Whether club staff serves intoxicated patrons is a reflection of the enforcement of club policies and of state laws by the management. Serving to intoxicated patrons has been strongly related to alcohol-related problems such as violence and drunk driving (Lang, Stockwell, Rydon, & Lockwood, 1995; Stockwell, Lang, & Rydon, 1993). Bartenders serving obviously intoxicated patrons were the strongest predictor

of alcohol-related harm (e.g., injury due to drinking) in a survey of patrons in Australian bars (Stockwell et al., 1993). Likewise, another study found that continuing to serve intoxicated patrons was related to increased alcohol risk, such as drunk driving (Lang et al., 1995).

Although the posting of warning signs has been related to lowered likelihood of serving to intoxicated patrons (Lenk, Toomey, & Erickson, 2006) and is encouraged by researchers (Healy, Cockfield, Mallick, & Banfield, 2008), studies have not yet examined whether warning or safety signage in clubs is related to lower levels of patron alcohol or drug use. Posting of warning signs may be management's way of reacting to prior or existing patron risk behaviors, or the club's attempt at preventing such behaviors. In either case, they reflect communication with staff and with patrons about safety, and represent a decision by management regarding enforcement of club policies.

In addition, few studies have examined the importance of isolated areas within nightclubs for alcohol or drug behaviors. The presence of isolated areas may reflect club managements' policies and decisions regarding the design of the club and designation of security patrols in such areas to prevent isolation. An observational study of urban bars reported that drug use typically occurred in isolated areas of the bars, where staff and other patrons could not see the drug use (Fox & Sobol, 2000).

The current study examines indicators of club management practices in clubs featuring EMDEs and their relation to biological assessments of alcohol (BAC) and drug use (i.e., marijuana (THC), cocaine, and amphetamines/MDMA). Although prior studies have provided important observed associations between management practices and patron behaviors, to date, the relationships between management practices and exit biological measures of alcohol and drug use by patrons has not been a focus. Further, prior studies have primarily focused on bar settings rather than venues featuring EMDEs, which are settings that may offer unique risks for young adults (Johnson et al., 2012; Miller, Byrnes, Branner, Voas, et al., 2013; Miller et al., 2009). Finally, prior studies focused on aggression, alcohol use and related consequences, not on drug use.

Based on prior work regarding club security and violence/disorder, increased club security practices were expected to be related to lower levels of alcohol and drug use at exit. Tight security may reflect active management styles that consciously discourage risk behaviors. Although studies have not examined relationships between safety signs and alcohol or drug use, more safety signs were also expected to be related to lower alcohol and drug levels. These practices suggest that management is concerned about these issues and is consciously setting a less permissive atmosphere.

In contrast, as prior research indicates that bar crowding and more instances of serving to intoxicated patrons are related to increased alcohol-related risks, these indicators were expected to be related to heavy alcohol and drug use at exit, as they may be indicators of management practices that are either neglectfully or consciously encouraging risk behaviors. Although few studies have examined the relation of isolated areas within the club to alcohol or drug use, it is expected that these secluded areas would be related to increased alcohol

and drug levels. Determining the specific club management practices that put patrons at increased risk is critical for providing safe settings for emerging adults, who frequently seek entertainment at these venues.

Methods

Data were collected at clubs in the San Francisco, CA area featuring electronic music dance events (EMDEs). Two types of data collection were conducted: 1) systematic observations at clubs and 2) portal biological assessments of patrons' alcohol and drug use, both upon entry and exit to the club. Clubs were selected based upon the type of events sponsored (EMDEs), a minimum of 200 patrons on weekend nights, and willingness to cooperate with the research. For the overall study, out of the 13 clubs meeting these criteria, 10 agreed to participate. Overall, we sampled 108 observational events and 70 portal events from the 10 clubs. Each club hosts different types of events during an average month. We collected data at multiple types of events for each of the clubs, including some that catered to younger patrons and some that catered to the LGBT community. The clubs were also located in different settings within the city to include some venues that were accessible by tourists.

Systematic Observations at Clubs

Club management practices and strategies for controlling the environment and ensuring safety for their guests were systematically observed for both interior and exteriors of each club. For the overall study, one hundred and eight observational events occurred in seven clubs (representing both nights that portals occurred and nights that they did not). For the current study, only observations and patron data collection that occurred on the same night were used, leaving 25 observations across six clubs for analyses. Two raters, one male and one female, observed each event and completed an observation checklist to indicate the features of the club observed. After an initial observation together, raters went to different parts of the clubs, allowing a larger area of the club to be covered, including both male/female bathrooms. As observers rated different parts of the club at different times in the evening, they may have observed different events and conditions, and so it is not expected that their assessments would be highly correlated. Observations were therefore not used to assess reliability. As indicated in the measures section, the highest score across observers for each event was used for analyses, as one observer may have seen more incidents than the other.

Each club's busiest evenings (usually Friday and Saturday) were chosen for assessment. Observations included how patrons entered the premises, all activities inside the club starting with early assessments before the club became crowded (9:45–10:00pm) until closing. Observers were instructed to act natural and blend into the environment. While they were attending the event, they recorded their activities using a protocol loaded onto a PDA. Observers arrived at the club and entered together, but separated at various points in the evening to make observations throughout the club. Observers made three rounds of observations. First, they observed the interior layout and signage of the club, then made general observations, observations of the interior, bar, and security. Then around 1:00 a.m.,

a peak period for clubs, general and interior observations were repeated. Bar observations were repeated after last call or 30 minutes before closing. Observers stayed until closing.

Portal data collection

Portal methodology (Johnson et al., 2012; Miller, Byrnes, Branner, Johnson, et al., 2013; Miller et al., 2005; Miller et al., 2009; Voas et al., 2006) was used to collect data anonymously from patrons at entrance and exit, with data linked through wristbands containing unique identification numbers. Portal data were obtained from 2,099 patrons who entered and exited 70 different events at 10 nightclubs from the end of April through November 2010, May through December 2011, and July through November 2012. For the current analyses, only participants who were enrolled in the study on the same night a systematic observation was conducted were retained, leaving 738 patrons at 25 events across six clubs for analyses.

Recruitment consisted of randomly approaching potential groups as they approached the club. Detailed recruitment procedures are presented in prior studies (Johnson et al., 2012; Miller, Byrnes, Branner, Johnson, et al., 2013). Among those who stopped to listen to the recruiter and were considered eligible (e.g., planning to enter club, not working at club), the percent of patrons participating had considerable variation across EMDEs (13% low to 93.8% high). The median participation rate was 57.9% across EMDEs in the overall sample (Miller, Byrnes, Branner, Voas, et al., 2013). The lowest response rate was atypical and occurred on a night when a professional football team was already in the club. Patrons were eager to go into the club and mingle with the team. Cold evenings also decreased the participation as the data collection occurred outside. Finally, refusal rates increased just prior to change in admission charges at a certain hour. Patrons were anxious to enter the club while they could still pay the lower fees. Although the research team addressed some of these issues (e.g., provided blankets, negotiated with club to allow patrons to be delivered to the door and pay lower fees), these were still impediments to participation. Anonymous participants provided informed consent before data collection began. Respondents were offered \$10 after entry data collection and \$20 after exit data collection. No names or other identifying information were collected from participants.

At entrance and exit, participants provided oral fluid and breath samples to test for alcohol and drug use, and completed a brief interview and self-administered survey. Most participants (89%) provided both entrance and exit data. Due to the anonymous nature of the data collection, there was no way to ensure that we had not previously interviewed the same participants at different events. Approximately 1.5% of participants reported that they had previously participated in one of our data collection events. All study procedures were approved by an Institutional Review Board.

The sample for these analyses ($N = 738$) consisted of 42.8% female patrons, with a median age of 26 (Mean = 27.47; SD = 7.88). Three-fourths (74.2%) of patrons were 30 or younger. More than one quarter (29.4%) of patrons reported being of Hispanic origin. Ethnicity/race was reported as follows: 53.0% White, 16.5% Asian, 12.2% African-American, 2.8% Pacific Islander, 0.4% Native American, 8.1% Multiracial, and 4.3% other race. The remaining 2.6% did not report their race. The majority of the sample were not students

(56.3%) and 51.0% had graduated from college or graduate/professional school. A range of incomes were reported: 26.6% made \$10,000 or less, 14.1% made \$10,001 to \$20,000, 19.9% made \$20,001 to \$40,000, 15.9% made \$40,001 to \$60,000, 12.8% made \$60,001 to \$80,000, and 10.7% made over \$80,000.

Measures

Observational proxy indicators of club management practices—Management practices were based on observation data. The highest score across observers for a given event was used for analyses, as observers did not always rate the same areas of the club or the same areas at the same time, and thus one observer may have witnessed more incidents than the other.

Club security scale: Observers assessed 12 items, reflecting 1) entrance procedures: thoroughness of ID security procedures (0 = *none*, 3 = *thorough comparison of face and id*), amount of patrons whose bags were checked (0 = *none*, 1 = *some patrons, regardless of sex*, 2 = *some men*, 3 = *all men*, 4 = *all patrons*), and amount of patrons who received pat-downs (0 = *none*, 1 = *some patrons, regardless of sex*, 2 = *some men*, 3 = *all men*, 4 = *all patrons*); and 2) security presence/visibility: two items regarding whether security were uniformed – one regarding inside security, and one regarding outside security (1 = *yes*, 0 = *no*, for both items), security patrols of the floor (1 = *no*, 2 = *main rooms only*, 3 = *most rooms*, 4 = *entire venue*), whether security checked the bathrooms (1 = *yes*, 0 = *no*), number of security staff on the floor, number of rooms with security staff present, and security staff presence in a) main room, b) non-main rooms, and c) bathrooms (1 = *none*, 5 = *visibly*). Items were standardized due to differing response scales and then averaged to create the security scale. Higher scores reflected more intensive security procedures (Cronbach's alpha = .78).

Bar crowding scale: Bar crowding was assessed at three different points of the evening – 1) at arrival between 9:45–10:00pm, 2) around 1:00 a.m., and 3) after last call or 30 minutes before closing. For each assessment, rating options ranged from 1 = *bartender(s) obviously not busy, has time to chat* to 5 = *bartender(s) having difficulty keeping up with orders*. Density of the bar was also measured at the three time points. Rating options for each assessment were from 1 = *sparse* to 5 = *packed*. The six assessments (three bar crowding assessments and three bar density) were averaged for analyses (Cronbach's alpha = .86).

Safety signage index: Observers indicated the types of signs they saw during the night, including both exterior and interior signs. Exterior signs included signs regarding: checking ID, age limits, the re-entry policy, and smoking policies. Interior signs included signs regarding: not serving intoxicated patrons, age limits/checking ID, maximum capacity of the club, smoking policies, and other interior safety signs. An index was calculated by counting the number of safety signs observed.

Serving intoxicated patrons: At the three different points during the night, observers noted the number of times patrons who appeared intoxicated were served alcohol. Items indicated whether seemingly intoxicated patrons were served or not, and a sum was computed to

reflect the number of times (0 – 3) successful purchase attempts by intoxicated patrons occurred throughout the night (Cronbach's alpha = .79).

Isolation: Three items assessed the potential for isolation at the club. The first two items indicated the number of isolated rooms, with each of the items reflecting a different observation point of the night. The third item indicated the number of non-dance rooms in the club, as these could be places where patrons could be less seen by staff and other patrons. Items were averaged for analyses (Cronbach's alpha = .74).

Portal data collection measures

Drug use: Drug use was assessed at entry and exit through the use of oral fluid samples using the Quantisal collection device (Immunoanalysis Corporation, Pomona, CA). Substances assayed were grouped into seven categories: (1) Tetrahydrocannabinol (THC), (2) Cocaine – including Benzoylecgonine, cocaethylene, norcocaine, (3) Amphetamine/MDMA— including methamphetamine, methylenedioxyamphetamine (MDA), methylenedioxyethylamphetamine (MDEA), (4) Opiates/analgesics—including morphine, codeine, oxycodone, 6 AM, Hydrocodone, Hydromorphone, oxycodone, (5) methadone, (6) phencyclidine (PCP), and (7) Ketamine. The highest level of drugs within each of these categories was used. Opiates/analgesics had different scales of measurement, so individual drug variables were standardized before using the highest level as an indicator of level of drug use. In the current study, level of Cocaine, THC, and amphetamines/MDMA were used as outcomes due to very low rates of other drugs.

Alcohol use: Estimated level of blood alcohol concentration (BAC) was based on breath samples collected at entry and exit using the Intoxilizer 400PA breathalyzer units (CMI, Inc., Owensboro, KY). The breath test at exit was missing in 11.7% of the cases. Of those missing, the reason was mainly due to the individual not completing the exit data collection (85.7%) and the recording of duplicate breathalyzer test numbers (11.2%). In cases where the breath test was missing, BAC level was estimated using data from the oral fluid sample (see Johnson et al., 2012, for details). Alcohol and drug test results were not available in the field.

Control variables: Patron demographic variables including gender (0 = *female*, 1 = *male*), ethnicity (0 = *non-White*, 1 = *White*), age, education (1 = *some high school* to 5 = *graduate or professional school*) and length of time in the club (in minutes) were controlled for.

Data Analyses

Because observations were clustered by club and event, mixed model regressions were conducted in SPSS 18 to account for non-independence of observations. Due to the short length of time between entry and exit, levels of alcohol/other drug use at entry (due to using alcohol/drugs before arrival) directly contribute to levels at exit (Miller, Byrnes, Branner, Johnson, et al., 2013). We conducted analyses predicting exit level of alcohol/other drugs without controlling for entry level to examine the cumulative risk from use during the night and how this risk was influenced by indicators of club management practices to inform

prevention strategies that focus on risks at exit. Demographic variables of gender, ethnicity, age, and education, in addition to the length of time in the club, were controlled for.

We also conducted analyses examining the change in levels of drug use from entrance to exit, using regression models with the level of each substance at exit as the dependent variable, controlling for drug use level at entrance and demographic variables. Levels of drug use at exit reflect a combination of drug use at entrance plus any drug used while at the club. However, even an increase in the drug used may not reflect use in the club, as this could reflect drug use prior to entry that was then absorbed in the body, causing elevated levels at exit. Due to this issue and to similar findings across models, we chose to present only the cumulative model here.

Results

Individual Drug and Alcohol Use at Exit

For this sample, THC was the most widely used illegal drug, with 16.9% of patrons testing positive at entry, and 18.6% positive at exit. Cocaine was used by 4.9% of patrons at entry, and 6.9% at exit. Amphetamines/MDMA were used by 4.9% of patrons at entry and 7.2% at exit. Rates for the other illegal drugs tested were: Opiates: 1.1% at entry, 0.9% exit; Ketamine: 0.7% at entry, 0.5% exit. PCP: 0.1% at entry, 0.3% at exit. No patrons had used Methadone at entry or exit.

At club entry, about half (52.4%) of individuals had used alcohol, while 25.5% were either impaired (BAC 0.05%: 9.9%) or legally intoxicated (BAC 0.08%: 15.6%). Average BAC at entry was 0.03% ($SD = 0.04\%$). At exit, 67.2% had used alcohol, and 40.9% were impaired or intoxicated. The average BAC at exit was 0.05% ($SD = 0.05\%$).

Indicators of Club Management Practices

Means and standard deviations for club management practices were examined. Overall, security was moderately thorough. Means and standard deviations for the standardized security scale were calculated for individual items composing the scale prior to standardization to be able to examine item distributions. ID security procedures on entrance were thorough, with a mean of 2.31 ($SD = 0.75$) on a 0 – 3 scale. The amount of patrons whose bags were checked ($M = 1.54$, $SD = 1.86$) and who received pat-downs ($M = 1.44$, $SD = 1.75$) were relatively low (both on 0 – 4 scales). Uniforms on inside (58.3% of the time) and outside (59.2% of the time) security were both observed a little more than half the time. Security patrols of the floor tended to cover most rooms ($M = 3.14$, $SD = 0.79$), while security were observed checking bathrooms less than half of the time (42.9%). The average number of security staff on the floor was 3.20 ($SD = 1.79$), and the average number of rooms with security staff present was 2.06 ($SD = 1.05$). Security staff presence in main rooms was moderately visible, with a mean of 3.12 ($SD = 1.30$) on a 5-point scale, while less so in other areas: non-main rooms, $M = 2.39$ ($SD = 1.11$) and bathrooms, $M = 1.68$ ($SD = 1.11$).

On average, bar crowding was moderate, with an average of 3.49 ($SD = 0.85$) on a five-point scale. Clubs tended to have relatively few safety signs visible, with clubs having on average about three signs ($M = 2.91$, $SD = 1.78$) out of the nine possible types of signs that observers

noted. On average, bartenders served apparently intoxicated patrons in between one and two of the three occasions observed ($M = 1.42$, $SD = 1.18$). Specifically, at time 1, observers witnessed that 28.6% of intoxicated purchases were successful. At time 2, 38.1% of purchase attempts were successful, while 46.2% were successful at time 3. In addition, clubs typically had one or two isolated rooms ($M = 1.48$, $SD = 1.05$).

Bivariate Correlations

Correlations were conducted to examine interrelationships among key variables (Table 1). More thorough security practices were significantly correlated with decreased levels of THC and amphetamines/MDMA. More bar crowding was significantly correlated with higher BAC and amphetamine/MDMA levels. A greater number of safety signs were significantly correlated with higher BACs among patrons. Higher rates of serving to intoxicated patrons was significantly correlated with higher levels of BAC and amphetamines/MDMA, and related to greater THC levels at the trend level.

Regression Models

Predicting cumulative exit substance use (i.e., drug use and heavy alcohol use)—Mixed model regressions were conducted to examine predictors of cumulative levels (pp/ml) of each substance at exit. Because entrance levels of substances contribute to the exit levels, due to the relatively short time period in the club ($M = 138.05$ minutes, $SD = 58.95$), these entrance and exit measures of each substance are not independent of each other. Because club management needs to be concerned with not only the change that occurs within the club in terms of substance use, but also the overall level of substance use upon exit, examining the cumulative exit levels is particularly important. In these models, exit level substance use was the dependent variable, while controlling for individual demographic variables (gender, ethnicity, age, education, and length of time in the club), but not entry levels of each substance.

Observable indicators of club management practices were related to levels of alcohol and drug use at exit (Tables 2 and 3). As may be expected, greater BAC levels at exit were significantly predicted by being in clubs that were observed serving intoxicated patrons more often. Higher levels of cocaine at exit were marginally predicted by fewer safety signs posted and, interestingly, by more intoxicated patrons being served, at the trend level. Higher levels of amphetamine/MDMA use at exit were significantly predicted by being in a club that serves intoxicated patrons more often. Club management practices were unrelated to cumulative THC levels at exit.

Discussion

Club management practices may allow for high levels of risky behavior through unorganized/neglectful management styles, or through management styles that consciously allow such behaviors. These types of management practices may send a message to patrons that such behavior is tolerated. A major finding from this study is that observed practices of over-serving were related to actual patron exit levels of alcohol use. This finding is consistent with other studies showing the relation of serving intoxicated patrons to alcohol-

related problems such as violence and drunk driving (Lang et al., 1995; Stockwell et al., 1993). However, an interesting finding from our study is that these same observable patterns of over-service were also related to exit drug use. Perhaps serving intoxicated patrons is an indicator of an unorganized management style, or an overall atmosphere of permissibility regarding behaviors that are tolerated, and drug users may tend to seek out such environments.

Although only significant at a trend level, clubs with a greater number of posted safety signs had lower levels of cocaine use. Few prior studies have examined the relationship of warning/safety signs to patron alcohol and drug use. This finding suggests that either: a) clubs are aware that their patrons are engaged in risky behaviors, and have posted signs in response; b) there are attempts to show some indication of responsible management by sign posting; or c) clubs with signs posted are more responsible, trying to not provide permissive environments. The signs may be effective as they are visible indicators to patrons that club management is concerned about such behaviors, clearly state the behaviors they will not tolerate, and that the club has clear and specific expectations for appropriate behavior in general. As such, drug users may be hesitant to use in atmospheres where clear guidelines are set for behaviors not tolerated. Alternatively, it is possible that drug users do not frequent clubs with many posted warning signs, as they know behaviors such as drug use will not be tolerated. It is impossible to know which possibility is accurate, as the history of how these signs were posted is unknown.

Although other club management practices (i.e., security practices, bar crowding) were related to drug and heavy alcohol use among patrons at the bivariate level, these practices were unrelated in multivariate analyses. Although security practices have been found strongly related to bar violence and disorder (Graham et al., 2006; Graham et al., 2012; Homel et al., 2004; Roberts, 2007; Wells et al., 2009) the relation of security practices to patron's heavy drinking or drug use had not been examined. It is possible that security practices are mainly focused on controlling aggressive/disorderly behaviors, rather than preventing drug or heavy alcohol use. In our field notes from observations, by the time security tended to intervene with alcohol-related problems, the person was already heavily intoxicated. In addition, there may have been no relation of security practices with drug use as this was much less frequent than alcohol use, and so security would detect it less often.

Although bar crowding was significantly related to higher BAC and higher levels of amphetamine/MDMA use in bivariate analyses, this significance disappears when controlling for demographic variables. This is in contrast to studies showing the relationship of more crowded venues and dance floors to greater alcohol use and intoxication (Graham, 1985; Hughes et al., 2011). This suggests that these demographic variables may be more important for heavy alcohol and drug use than bar crowding. In addition, when the bar is crowded it may be more difficult for staff to see patrons' behavior as easily. It is possible that in these cases, drug/excessive alcohol use is more likely to go undetected.

The presence of isolated areas was also unrelated to drug or heavy alcohol use, in contrast to an observational study that noted drug use in such bar niches (Fox & Sobol, 2000). A more nuanced measure of isolation in club areas may be needed. The degree of isolation may be

the issue that is more important than the number of isolated rooms, in providing opportunities for drug or heavy alcohol use. For example, an isolated area may be very secluded with little possibility that someone could walk in, or instead, it could be set off from the main rooms, but still in sight of other patrons. Future studies should examine the level of isolation in predicting drug and heavy alcohol use.

Limitations of the study should be considered. Street recruitment at clubs is difficult and creates some limitations. This type of recruitment requires that clubs allow the research team to set up a data collection site near the venue. This may limit the generalizability of findings as access to clubs may be related to characteristics of the patrons. Recruitment rates also varied widely across EMDEs. However, variations appear due to factors such as weather, irrespective of the club or type of event occurring. Given that we collected data on a number of different nights, we captured a variety of different conditions. Therefore, it is unlikely this variation biased study results. In addition, this study was conducted in one large U.S. West Coast city and so findings might not be generalizable to other areas. However, the San Francisco area is very diverse ethnically and economically, and the resulting club sample was diverse as well. This suggests that findings would likely apply to a wider group, including individuals from different ethnic backgrounds and in other cities.

Despite the limitations, the study contributes several key points to our understanding: First, observable club practices are related to patron behaviors; Second, both drug and alcohol use of patrons are related to observable club practices; Third, this is a multi-method study that allows examining two different types of data that are related; and Fourth, results are further strengthened by the use of biological measurements of alcohol and drug use on a relatively large scale, and measures from multiple venues and events. Findings have implications for creating safer nightclub settings for young adults, as they point to management practices that could be targeted in preventing drug use. Focusing on strategies to increase the posting of safety signs related to drugs or alcohol should be encouraged. In addition, training staff in responsible service practices may be key to maintaining an atmosphere that makes clear the type of behavior that is not tolerated. This should include training bar staff to recognize signs of intoxication and enforcing club policies regarding service to intoxicated patrons. Although responsible beverage service (RBS) can be effective (Saltz, 1997), avoiding service to intoxicated patrons may be a difficult aspect of RBS to maintain (Clapp et al., 2009). More research is needed to determine how to most effectively implement such programs. Overall, these findings suggest that working directly with club management on environmental strategies may be a promising avenue for encouraging club safety and preventing health risk behavior. Additional work is in progress to test an environmental preventive approach based on these results that is focused on mobilization and strategies for reducing risks related to interior and exterior environments, management practices, and staff skills.

Acknowledgments

This study was supported by National Institute on Alcohol Abuse and Alcoholism (NIAAA) 1 RC1-AA019110-01 “Drinking Patterns at Clubs: Using Oral Assays and Portal Methodology”, B.A. Miller, PI, and National Institute on Drug Abuse (NIDA) 5 R01-DA018770-04 “Prevention of Young Adult Drug Use in Club Settings,” B.A. Miller,

PI. The contents of this paper are solely the responsibility of the authors and do not necessarily represent official views of NIAAA, NIDA, or NIH.

References

- Arria A, Yacoubian G, Fost E, Wish E. Ecstasy use among club rave attendees. *Archives of Pediatrics and Adolescent Medicine*. 2002; 156:295–296. [PubMed: 11876678]
- Barrett SP, Gross SR, Garand I, Pihl RO. Patterns of simultaneous polysubstance use in Canadian rave attendees. *Substance Use and Misuse*. 2005; 40(9–10):1525–1537. [PubMed: 16048831]
- Chinet L, Stephan P, Zobel F, Halfon O. Party drug use in techno nights: a field survey among French-speaking Swiss attendees. *Pharmacology Biochemistry and Behavior*. 2007; 86(2):284–289.
- Clapp JD, Reed MB, Min JW, Shillington AM, Croff JM, Holmes MR, Trim RS. Blood alcohol concentrations among bar patrons: A multi-level study of drinking behavior. *Drug and Alcohol Dependence*. 2009; 102(1–3):41–48. [PubMed: 19250775]
- Degenhardt L, Dillon P, Duff C, Ross J. Driving, drug use behaviour and risk perceptions of nightclub attendees in Victoria, Australia. *International Journal Of Drug Policy*. 2006; 17(1):41–46.
- Fox, James; Sobol, James. Drinking patterns, social interaction, and barroom behavior: a routine activities approach. *Deviant Behavior*. 2000; 21:429–450.
- Furr-Holden D, Voas RB, Kelley-Baker T, Miller B. Drug and alcohol-impaired driving among electronic music dance event attendees. *Drug and Alcohol Dependence*. 2006; 85(1):83–86. [PubMed: 16675160]
- Graham, K. Determinants of heavy drinking and drinking problems: the contribution of the bar environment. In: Single, E.; Storm, T., editors. *Public Drinking and Public Policy*. Toronto: Addiction Research Foundation; 1985. p. 71–84.
- Graham K, Bernards S, Osgood DW, Wells S. Bad Nights or Bad Bars? Multi-level Analysis of Environmental Predictors of Aggression in Late-Night Large-Capacity Bars and Clubs. *Addiction*. 2006
- Graham K, Bernards S, Osgood DW, Wells S. 'Hotspots' for aggression in licensed drinking venues. *Drug and Alcohol Review*. 2012; 31(4):377–384. [PubMed: 22050319]
- Green J, Plant MA. Bad bars: A review of risk factors. *Journal of Substance Use*. 2007; 12(3):157–189.
- Gripenberg-Abdon J, Elgan TH, Wallin E, Shaafati M, Beck O, Andreasson S. Measuring substance use in the club setting: a feasibility study using biochemical markers. *Substance Abuse Treatment, Prevention, and Policy*. 2012; 7:7.
- Healy, D.; Cockfield, S.; Mallick, J.; Banfield, K. "Pubs and Clubs" Project – modifying risky alcohol-related on-road behaviours; Paper presented at the Joint ACRS-Travelsafe National Conference; 2008.
- Hommel, Ross; Carvolth, Russell; Hauritz, Marge; McIlwain, Gillian; Teague, Rosie. Making licensed venues safer for patrons: what environmental factors should be the focus of interventions? *Drug and Alcohol Review*. 2004; 23(1):19–29. [PubMed: 14965884]
- Hughes K, Quigg Z, Eckley L, Bellis M, Jones L, Calafat A, Kosir M, van Hasselt N. Environmental factors in drinking venues and alcohol-related harm: the evidence base for European intervention. *Addiction*. 2011; 106(Suppl 1):37–46. [PubMed: 21324020]
- Johnson M, Voas R, Miller BA, Holder H. Predicting Drug Use at Electronic Music Dance Events: Self-Reports and Biological Measurement. *Evaluation Review*. 2009; 33(3):211–225. [PubMed: 19351889]
- Johnson M, Voas RB, Miller BA. Driving decisions when leaving electronic music dance events: Driver, passenger, and group effects. *Traffic Injury Prevention*. 2012; 13:1–8.
- Kurtz SP, Surratt HL, Levi-Minzi MA, Mooss A. Benzodiazepine dependence among multidrug users in the club scene. *Drug And Alcohol Dependence*. 2011; 119(1–2):99–105. [PubMed: 21708434]
- Lang E, Stockwell T, Rydon P, Lockwood A. Drinking settings and problems of intoxication. *Addiction Research*. 1995; 3:141–149.
- Lenk KM, Toomey TL, Erickson DJ. Propensity of Alcohol Establishments to Sell to Obviously Intoxicated Patrons. *Alcoholism: Clinical and Experimental Research*. 2006; 30(7):1194–1199.

- Leonard KE, Collins RL, Quigley BM. Alcohol consumption and the occurrence and severity of aggression: An event based analysis of male to male barroom violence. *Aggressive Behaviour*. 2003; 29:346–365.
- Leonard KE, Quigley BM, Collins RL. Drinking, personality, and bar environmental characteristics as predictors of involvement in barroom aggression. *Addictive Behavior*. 2003; 28(9):1681–1700.
- Miller BA, Byrnes HF, Branner A, Johnson M, Voas R. Group influences on individual's drinking and drug use at clubs. *Journal of Studies on Alcohol and Drugs*. 2013; 74:280–287. [PubMed: 23384376]
- Miller BA, Byrnes HF, Branner AC, Voas R, Johnson MB. Assessment of Club Patrons' Alcohol and Drug Use: The Use of Biological Markers. *American Journal of Preventive Medicine*. 2013; 45(5): 637–643. [PubMed: 24139778]
- Miller BA, Furr-Holden CD, Voas RB, Bright K. Emerging adults' substance use and risky behaviors in club settings. *Journal of Drug Issues*. 2005; 35(2):357–378.
- Miller BA, Furr-Holden D, Johnson M, Holder H, Voas RB, Keagy C. Biological Markers of Drug Use in the Club Setting. *Journal of Studies On Alcohol and Drugs*. 2009; 70(2):261–268. [PubMed: 19261238]
- Ramo DE, Grov C, Delucchi K, Kelly BC, Parsons JT. Typology of club drug use among young adults recruited using time–space sampling. *Drug and Alcohol Dependence*. 2010; 107(2–3):119–127. [PubMed: 19939585]
- Roberts JC. Barroom aggression in Hoboken, New Jersey: don't blame the bouncers! *Journal of Drug Education*. 2007; 37(4):429–445. [PubMed: 18351181]
- Saltz RF. Evaluating specific community structural changes. Examples from the assessment of responsible beverage service. *Eval Rev*. 1997; 21(2):246–267. [PubMed: 10183277]
- Stockwell T, Lang E, Rydon P. High risk drinking settings: the association of serving and promotional practices with harmful drinking. *Addiction*. 1993; 88(11):1519–1526. [PubMed: 8286997]
- Voas RB, Furr-Holden D, Lauer E, Bright K, Johnson MB, Miller BA. Portal surveys of time-out drinking locations: A tool for studying binge drinking and AOD use. *Evaluation Review*. 2006; 30:44–65. [PubMed: 16394186]
- Voas RB, Johnson MB, Miller BA. Alcohol and drug use among young adults driving to a drinking location. *Drug and Alcohol Dependence*. 2013; 132:69–73. [PubMed: 23415848]
- Wells S, Graham K, Tremblay PF. "Every male in there is your competition": young men's perceptions regarding the role of the drinking setting in male-to-male barroom aggression. *Substance Use & Misuse*. 2009; 44(9–10):1434–1462. [PubMed: 19938926]

Table 1

Correlations among key variables

Variables	1	2	3	4	5	6	7	8	9
1. Club security	-								
2. Bar crowding	-0.200***	-							
3. Safety signs	0.011	-0.032	-						
4. Serve intoxicated	-0.097**	0.071‡	-0.019	-					
5. Isolation scale	0.337***	-0.089*	-0.055	0.186***	-				
6. BAC level at exit	-0.035	0.126**	0.297***	0.158***	0.006	-			
7. THC level at exit	-0.101*	0.022	0.007	0.076‡	-0.036	0.037	-		
8. Cocaine level at exit	-0.059	0.038	-0.047	0.054	-0.056	-0.013	-0.003	-	
9. Amphetamine/MDMA level at exit	-0.080*	0.084*	-0.039	0.136**	-0.011	0.025	0.410***	0.007	-

Table 2

Mixed Model Regression Analysis Predicting Cumulative BAC at Exit

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>
BAClevel at exit				
<i>Individual</i>				
Female	−0.561	0.401	−1.398	0.163
Non-white	−1.062	0.407	−2.607	0.009
Time in club	−0.004	0.004	−1.017	0.310
Age	−0.078	0.029	−2.722	0.007
Education	0.418	0.237	1.767	0.078
<i>Club characteristics</i>				
Club Security	0.381	0.976	0.390	0.702
Bar crowding	0.347	0.446	0.777	0.447
Safety signs	0.329	0.224	1.467	0.158
Serve intoxicated	0.640	0.292	2.191	0.043
Isolation Scale	−0.149	0.325	−0.460	0.652

Table 3

Mixed Model Regression Analysis Predicting Cumulative Cocaine and Amphetamine/MDMA levels at Exit

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Cocaine level at exit				
<i>Individual</i>				
Female	−179.648	228.685	−0.786	0.432
Non-white	−261.603	229.327	−1.141	0.254
Time in club	−3.029	1.992	−1.521	0.129
Age	20.111	15.774	1.275	0.203
Education	91.212	133.785	0.682	0.496
<i>Club characteristics</i>				
Club Security	26.710	226.783	0.118	0.906
Bar crowding	126.044	142.912	0.882	0.378
Safety signs	−129.815	67.626	−1.920	0.055
Serve intoxicated	176.868	103.676	1.706	0.089
Isolation Scale	−147.142	114.245	−1.288	0.198
Amphetamine/MDMA level at exit				
<i>Individual</i>				
Female	−137.998	91.948	−1.501	0.134
Non-white	−5.943	92.747	−0.064	0.949
Time in club	−0.884	0.809	−1.093	0.275
Age	−2.957	6.451	−0.458	0.647
Education	−68.009	54.166	−1.256	0.210
<i>Club characteristics</i>				
Club Security	−137.960	130.844	−1.054	0.329
Bar crowding	105.840	69.120	1.531	0.143
Safety signs	−28.263	34.699	−0.815	0.427
Serve intoxicated	137.223	47.795	2.871	0.010
Isolation Scale	−10.023	52.518	−0.191	0.851