

# Substance Use and Community Violence: A Test of the Relation at the Daily Level

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Prior research has consistently demonstrated an association between substance use and involvement in violence among individuals with mental illness. Yet little is known about the temporal quality of this relationship, largely because longitudinal data required to address this issue are not readily available. This study examined the relationship between substance use (alcohol, marijuana, and other drug use) and violence at the daily level within a sample of mentally ill individuals at high risk for frequent involvement in violence ( $N = 132$ ). Results support the serial nature of substance use and violence, with an increased likelihood of violence on days following the use of alcohol or multiple drugs, but not the inverse relationship. Implications for the utility of substance use as a risk marker for the assessment of future violence are discussed.

*Keywords:* substance use and violence, violence in mentally ill individuals, management of violence, daily reports of violence

Considerable research has been conducted to refine methods for predicting the likelihood of violence in individuals with mental illness (McNeil et al., 2002). This work has consistently identified substance use and abuse as critical factors to consider when assessing the risk for future violence, as studies repeatedly document a strong association between these two behaviors. In cross-sectional studies, individuals who endorse items that characterize

substance abuse disorders are also more likely to endorse items indicating involvement in recent violence (Mulvey, 1994; Swanson, Holzer, Ganju, & Jono, 1990). Similarly, in prospective studies, psychiatric inpatients diagnosed with co-occurring mental and substance abuse disorders are at the highest risk for involvement in violence when they are later discharged to the community (Steadman et al., 1998; Swanson et al., 2002). Retrospective patient reports of substance use in the community, particularly alcohol use, coincide with retrospective reports of involvement in violence during the same period (Skeem, Mulvey, & Lidz, 2000; Soyka, 2000; Swartz et al., 1998).

Although the strong association documented in previous studies makes substance use a prime candidate to consider in the search for risk factors regarding violence, the exact nature of the relationship between substance use and violence is still poorly understood. There are several ways in which substance use and violence may be related. First, substance use may cause violence, either through direct disinhibition or through an indirect effect on other factors that heighten the risk of violence (e.g., intense involvement in groups prone to aggression; stressed interpersonal relationships; compromised coping resources) in the days surrounding substance use. Second, violent encounters may increase the likelihood of using substances by, for example, an individual using substances to cope with the aftermath of the event. Finally, it is plausible that the relationship between substance use and violence is a spurious one caused by some other influence, such as life stressors, promoting either or both of these behaviors (Parker & Auerhahn,

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1998; White, 1990, 1997). Any of these competing models could produce the association between substance use and violence that has been previously observed within samples of mentally ill individuals. Determining whether there is a clear temporal relationship between substance use and violence is a prerequisite both for determining potential causality and for assessing whether interventions that reduce substance use would have any appreciable impact on the occurrence of violent incidents (see Douglas & Skeem, 2005; Kraemer et al., 1997).

Unfortunately, extant research on the general population, although more extensive, does not provide definitive guidance. This research often indicates a direct relationship between alcoholic intoxication and interpersonal violence (Chermack, Fuller & Blow, 2000; Collins, 1989; Fagan, 1993; Pernanen, 1991), particularly for individuals with a demonstrated proneness for aggression (Lang & Kidorf, 1990). Research also indicates that alcohol consumption promotes violence in part because people expect it to do so (Paglia & Room, 1999). Regardless of whether they have actually consumed alcohol, people who believe they have consumed alcohol behave more aggressively (Bushman, 1997; see also Collins, 1989; Fagan, 1990). Intentionally or unintentionally, people may view intoxication as a "time-out" from full accountability for one's behavior (MacAndrew & Edgerton, 1969; Zack & Vogel-Sprott, 1997).

Results on the relationship of drug use and violence in the general population are less clear. Although there is little evidence to suggest that illicit drug use is directly associated with violence (Parker & Auerhahn, 1998), there is an open possibility that drug involvement is indirectly linked with violence through illegal activities to obtain money to buy drugs and through efforts to control the drug market (Fagan & Chin, 1990; Goldstein, 1985). There is, however, evidence that the use of multiple substances increases the risk of violence. Poly-substance abusers in treatment obtained significantly higher scores on self-report measures of hostility and aggression than did single-substance abusers, regardless of the particular types of drugs and drug combinations used (McCormick & Smith, 1995). In addition, Bennett (2000) found an exponential relationship between the number of drug types that arrestees used during a 1-year period and the number of acquisitive offenses that occurred during that same period. It may be that poly-substance abusers have personality traits (particularly antagonism and impulsiveness) that predispose them toward violence (McCormick, Dowd, Quirk, & Zegarra, 1998), that poly-substance use prompts more instrumental violence and acquisitive crime to maintain a multiple-drug habit (Bennett & Hollaway, 2005; Smith & Polsenberg, 1992), or that poly-substance use coincides with heavier involvement in a deviant, problematic, and "excessive" lifestyle than does single-substance abuse. Alternatively, the use of multiple drugs may interact to increase intoxication, which places one at greater risk for violence than does single-drug use.

This study addresses two issues regarding the relationship of substance use and violence in individuals with mental illness. First, it examines the strength of the relationship between these two behaviors in a select sample of individuals with mental illness who are at high risk for violence, looking at the effects of specific types of substance use and the effects of poly-substance use. We hypothesized that higher levels of certain types of substance use (alcohol in particular) and the use of more types of substances increase the likelihood of violence. We did not, however, expect to

see comparable effects when substances were examined separately, with alcohol being the substance most likely to be linked consistently to violence. Second, this study tests whether there is a temporal relationship between substance use and violence or vice versa. We expected that each type of substance use and the use of multiple substances would precede violence but that violence would not precede substance use. We also expected a rather weak relationship of any given substance to violence on the subsequent day. This information is essential for informing the scientific debate about the mechanisms of the connection between these two behaviors as well as refining methods for assessing and intervening to avoid future violence.

This study has two important features that allow it to address these issues well. First, the sample represents a population of mentally ill individuals deemed to be at a high risk for involvement in future violence—individuals who are most likely to be enrolled in community-based intervention programs to reduce violence. Second, the intensive and multi-informant measurement approach provides a daily account of both substance use and involvement in violence during a 6-month follow up period. The increased resolution of reporting allows for the relationship between substance use and violence to be tested in a more exact fashion than is usually possible (for a notable exception, see the work of Fals-Stewart and his colleagues discussed below; Fals-Stewart, 2003; Fals-Stewart, Golden, & Schumacher, 2003).

## Method

### *Recruitment of Study Participants*

Participants were sampled from among patients who were evaluated in the emergency room of an urban psychiatric hospital in the northeastern United States. The sampling method, using a prescreening procedure and a screening interview, identified individuals who were at a high risk for involvement in repeated violence (based on Gardner, Lidz, Mulvey, & Shaw, 1996). A prescreen based on initial file review identified individuals who came to the emergency room with the following requirements: (a) young age (14–30 years), (b) a history of violence toward others, and (c) a lack of marked thought disorder (i.e., current diagnosis of schizophrenia or current report of delusions). The latter criterion, which was empirically derived (Gardner et al., 1996), is consistent with other research indicating that symptoms of psychosis, although often clinically relevant for understanding violence in a small proportion of individuals, are generally weak predictors of violence when applied to broad samples of mentally ill individuals (e.g., Monahan et al., 2001; Wessely, Castle, Douglas & Taylor, 1994; for a review, see Douglas & Skeem, 2005). Individuals who had diagnoses of moderate to profound mental retardation were excluded from recruitment. Of those who met the prescreening requirements ( $N = 1,044$ ) and subsequently consented (participation of minors also required parental consent), about half completed the screening interview ( $n = 517$ ). Individuals were then identified as eligible for inclusion in the sample for follow up in the community if they had (a) heavy drug or alcohol use within the prior 2 months, (b) at least one recent violent threat or act within that time, and (c) a Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983) Hostility subscale score of 7 or higher. The specifics of these criteria as well as the characteristics of the samples at each of these stages of review are provided in Skeem, Mulvey, Lidz, Gardner, and Schubert (2002).

### *Interviewing Study Participants and Collateral Informants*

Individuals deemed eligible based on the screening interview were invited to take part in the study, which consisted of a baseline interview and

26 weekly interviews.<sup>1</sup> Eligible research participants and collateral informants who agreed to take part in the study completed a baseline interview, which focused on characterizing the research participant's life with respect to the following domains: living situation, employment or school status, social supports and relationship quality, substance use, symptoms (as assessed by the BSI), violence, and involvement in the mental health treatment and legal systems. Attempts were made to conduct 26 weekly interviews with research participants and collateral informants, beginning either upon hospital discharge (for hospitalized individuals) or 1 week after the baseline interview (for individuals who returned to the community after their emergency room visit). These follow-up interviews focused on characterizing the study participant's life across the domains of interest over the previous week, providing information at the daily level when possible for several domains. These efforts produced a data set with completed interview data for 92% of the possible follow-up interview data points. Additional details regarding the procedures used in recruiting, tracking, and retaining research participants are provided in Schubert, Mulvey, Lidz, Gardner, and Skeem (2005).

### Measures

The weekly interviews integrated information from multiple domains of the research participant's week, providing orientation points from one sphere of life activities to prompt recall from another sphere (see Schubert et al., 2005, for details of the interviewing process). This method of reconstructing events over the recall period closely resembles that used by Horney and her colleagues (e.g., Horney, 2001) to obtain reports of violent incidents and by numerous researchers who use timeline followback techniques to gather alcohol and drug use information (e.g., Midanik et al., 1998; Sobell, Brown, Leo, & Sobell, 1996).

**Violence.** The occurrence and type of violence at the daily level was based on information from the weekly interviews with both study participants and collaterals. Involvement in violent incidents was measured in terms of date of occurrence, nature, and severity of each incident reported as occurring during the time period covered by each interview. First, patients and collateral informants were asked whether the patient had engaged in any of nine categories of aggressive acts (e.g., pushing, hitting, using a weapon) during the defined period, based on Lidz, Mulvey, and Gardner's (1993) adaptation of the Conflict Tactics Scale (CTS; Straus & Gelles, 1990). For each category of behavior endorsed, respondents were asked to list the number of times that the act occurred. An account of each incident was then elicited, and only the most serious aggressive act for each discrete violent incident was coded. Finally, specific contextual information about each violent incident was gathered (e.g., location, co-combatant, degree of injury). This approach is very similar to ones used in studies of intimate partner violence, with very good psychometric properties (e.g., the Timeline Followback Spousal Violence Interview; Fals-Stewart, Birchler, & Kelley, 2003).

Violence was coded as occurring if either the research participant or the collateral informant endorsed any of the violent acts listed, unless that action was clearly taken in self-defense (e.g., in the course of being the victim of a mugging). Incidents of child discipline were also excluded. In keeping with Steadman et al. (1998), violence was further coded into two levels. Serious violence was defined as an aggressive act that resulted in physical injury (from bruises to death), a sexual assault, a threat made with a weapon in hand, or an aggressive act that involved the use of a weapon. Minor violence was defined as physical battery that did not result in injury. Each day of the follow-up period was characterized as being a violent or a nonviolent day for whether serious violence occurred or whether any violence occurred. This allowed us to examine violence using a more conservative (serious violence) or liberal (any violence) threshold. Given the consistency of results found for both types of violence, results are presented for serious violence only, with notable findings for any violence included as a footnote or brief comment.

**Substance use.** Information from the weekly interviews with study participants was used to assess the type and level of substance use at the daily level. Information about substance use was gathered by asking research participants about the frequency, type, and amount of alcohol and drugs that they had used, based on the Drug and Alcohol Use Inventory developed in prior work (Lidz et al., 1993; Monahan et al., 2001). To characterize alcohol use, patients were questioned about the amount of alcohol they had consumed during the week prior to the interview (i.e., how many times they drank in the past week, and, for each day of the week on which they drank, how much beer, wine and liquor they consumed). Their rate of alcohol consumption during the follow-up interval was expressed in number of drinks per day. For analyses characterizing daily usage patterns, a day was counted as a "drinking day" if the research participant indicated consumption of three or more drinks that day. This threshold is within the range of "moderate" to "heavy" drinking (Sanchez-Craig, Wilkinson, & Davila, 1995; U.S. Department of Health and Human Services, Department of Agriculture, 2000), and slightly below commonly defined "binge drinking" (Wechsler & Austin, 1998). It was chosen because it indicated a significant level of drinking in a day and the distribution of the reported number of drinks per day showed a marked rise and leveling in reports at this point.

To characterize drug use, research participants were questioned about whether they used various classes of drugs during the week prior to the interview. If they endorsed the use of illegal drugs during this time period, they were then asked on which day they used the drug endorsed. Given the possibility that different substances may demonstrate different patterns of relationships with violence, we separately examined the effects of three different types of substances used with adequate frequency by this group of individuals (i.e., alcohol, marijuana, and "other" drugs). The relations between multiple drug use days (e.g., days when individuals used, for example, both alcohol and marijuana) and violence was also estimated, allowing for the possibility that the interplay between substance use and violence may vary as a function of concurrent use within days. The reliability of these estimates of drinking and drug use was considered adequate according to analyses of similar methods that measured recall over a longer period (Lemmens, 1998; Sobell & Sobell, 1992; Sobell, Sobell, Leo, & Cancilla, 1988).

The collapsing of multiple types of drug use other than alcohol and marijuana into a single "other drug" category was done primarily because of the low frequency of use of any one other drug. The most frequent drugs used in this category were cocaine and sedatives (see the Results section below). Because these different drugs were considered as one class, it is possible that specific drugs might be showing different relations with violence that would not be detected with the methods used here.

### Reconciling Conflicting Sources of Information

As mentioned above, the reports of research participants and collateral informants were used to determine whether and what type of violence occurred. While providing a complete picture, the use of multiple sources of information can also produce conflicting reports. The results in this study followed the general pattern seen in prior research using collateral informants regarding violence and substance use (see Mulvey, Shaw & Lidz, 1994), with the overwhelming number of reports of substance use or violence coming from participant reports, with collateral reports increasing

<sup>1</sup> Separate informed consent was obtained for involvement in each phase of the study, and parental informed consent was obtained for those individuals under the age of 18. A collateral informant was chosen for each participant, based on the participant's nomination of individuals who knew him or her well. Informed consent was obtained from this individual as well (and from a parent if needed) for involvement in these repeated interviews.

the overall number of days with reported substance use or violence by approximately 20%. For approximately one third of the days covered, collateral reports were missing or the collateral did not know the participant's activities.

When the conflict concerns whether a violent incident occurred, the most likely sources of error are arguably that the event is unknown to a source (collateral informant) or that a source does not wish to acknowledge the event (research participant or collateral informant). Therefore, any report of the occurrence of a violent incident was assumed to be a correct report. When conflicts existed regarding the details of a violent incident (e.g., the identity of a co-combatant), a system relying on group consensus was used to devise a "most plausible account" of the incident. This involved the principal investigators, the project coordinator, and a research associate applying a body of decision rules to cases in which the details of incidents differed among the sources and reaching an agreed upon version of the type and timing of the incident.<sup>2</sup>

### Data Imputation Process

As mentioned previously, a very large proportion (92%) of the possible days for reporting were covered by interviews with participants or collaterals. Nonetheless, a data imputation procedure was used to construct a "complete" data set for sequential analyses to follow recommended practice for such situations (Rubin, 1987; Schafer & Graham, 2002; Schafer & Olsen, 1998). A two-step data imputation process was used to determine values for days that had missing information for either violence or substance use (based on Schafer, 1997). In the first step, each day that had missing reports of either violence or substance use was randomly assigned to be a violent/nonviolent, drinking/nondrinking, or drug use/no drug use day in proportion to the frequencies of these types of days in the series of observations for that study participant. In the second step, for days that were randomly chosen to be "drinking days," a random value between the minimum and maximum values for the amount of drinks consumed on any given drinking day observed for that study participant was then inserted. Because of the low level of missing interviews overall, we decided to generate only a single imputed data set of violence and substance use.

### Results

In this section, we describe participants' basic characteristics and base rates of violence and substance use during the follow-up period. We then analyze the co-occurrence of substance use and serious violence. Finally, we examine the time-ordered relationship between substance use and serious violence. Given that serious forms of violence are more salient for clinical and policy discussions and that the pattern of relationships between substance use and violence does not differ when "any violence" is considered, we present only the results for serious violence.

### Background Information

**Participant characteristics.** Table 1 shows the characteristics of the 132 research participants. These individuals were young ( $M = 21$  years,  $SD = 6$  years) men and women (52%) who were equally likely to be White or African American (49%; other = 2%). Of the 83 research participants age 18 years and older, 65% had attained at least a high school degree and one third were living with their parents. Research participants had hospital chart diagnoses of affective (76%) and substance abuse (45%) disorders, as well as comorbid Axis I and substance abuse disorders (45%). They had an average of 1.7 prior psychiatric hospitalizations ( $SD = 2.5$ ), and 60% had a recorded history of attempted suicide.

Table 1  
*Conditional Probabilities of Substance Use and Serious Violence Co-occurring on a Given Day*

Event	Conditional probability (%)
P(violence)	1.4
P(violence / alcohol only)	2.3
P(violence / marijuana only)	1.6
P(violence / other drug only)	2.5
P(violence / alcohol and marijuana)	4.4
P(violence / alcohol and other drugs)	4.5
P(violence / alcohol, marijuana, other drugs)	9.0
P(alcohol)	8.7
P(alcohol / violence)	21.7
P(marijuana)	20.6
P(marijuana / violence)	32.4
P(other drug use)	2.5
P(other drugs / violence)	6.2
P(alcohol and any drug use)	9.3
P(alcohol and any drug use / violence)	23.1

Note. P = probability.

There were no significant differences between the male and female participants on chart information regarding Global Assessment of Functioning (GAF) score, whether there was a substance abuse or dependence diagnosis, whether there was a personality disorder diagnosis, or the mean number of different diagnoses recorded (data not reported).

The sampling strategy used here was based on an algorithm developed in this emergency room for identifying individuals highly likely to be involved in repeated violence (Gardner et al., 1996). The proportion of women in the sample reflects previous findings from this site and others indicating that, in samples of individuals in acute psychiatric care settings, female individuals have an equivalent likelihood of involvement in violence (Lidz et al., 1993; Monahan et al., 2001). The lack of Latino and other minority participants reflects the very limited number of these individuals in the population base of the area.

Collateral informants were most often a female individual in the participant's life, with 39% of them evenly split between the participant's mother or a female friend. Male friends constituted 15% of the collaterals. Collaterals were, on average, 30 years old ( $SD = 13.1$ ) and had known the participant for 14.3 years ( $SD = 15.9$ ). These individuals reported talking to the participants six times per week on average ( $SD = 2.1$ ).

Participants were followed for an average of 183.9 consecutive days ( $SD = 6.3$ , range = 140–196), with an average of 163.5 days ( $SD = 36.2$ , range = 14–195) spent in the community. Sixty-one percent of the study participants ( $n = 81$ ) had periods of varying lengths ( $M = 16.6$  days,  $SD = 29.2$  days) when they were in either a jail or a mental hospital during the follow-up period. Although

<sup>2</sup> The coding rules governing this decision process are available from the authors.

individuals may have obtained illegal substances and been involved in violence during these periods of institutionalization, these situations arguably are qualitatively different from community life and are thus likely to yield a different set of relationships between the two behaviors examined. As a result, the analyses presented here examine only periods containing days at risk in the community, with the majority of the participants having extended community observational periods.

*Participants' violence.* The overwhelming majority (88.1%) of the sample reported engaging in a violent act within the community during the follow-up period. Among participants who reported involvement in community violence, the average number of within-person community violent incidents was 5 for minor violence ( $SD = 4.6$ ; range = 1–30) and 4 for serious violence ( $SD = 3.2$ ; range = 1–16).

*Participants' substance use.* Given the selection criteria for this study, it is not surprising that the rates of reported substance use are appreciably higher than those seen in more general samples of mentally ill individuals (e.g., Regier et al., 1990). Very few participants ( $n = 6$ ; 4.5%) reported neither alcohol nor drug use over the follow-up period. The overwhelming majority of participants endorsed poly-substance use over the follow-up period, with 70.5% endorsing all three types of substances (alcohol, marijuana, and other drugs), 18.9% endorsing use of two of the three substances, and only a small percentage (6.1%) reporting use of a single substance (alcohol only,  $n = 1$ ; marijuana only  $n = 3$ ; other drugs  $n = 4$ ).

Among the 88% of research participants who reported drinking during the follow-up, the average number of days of drinking was 21.6 ( $SD = 23$ ), and the average number of drinks consumed on a drinking day was 6.0 ( $SD = 4.6$ ). Among the 80% of the sample who reported using marijuana, the average number of days of use was 40 over a follow-up period that averaged 183 days. The most commonly used other drugs were as follows: 32% with cocaine use (average of 8 days used); 27% with sedative use (average of 5 days used); and 7% with crack cocaine use (average of 2 days used).

### *Co-Occurrence of Substance Use and Violence*

As in previous studies, an association at the aggregate level between alcohol use and violence was found in this sample. After controlling for days at risk in the community in a multiple-regression analysis, a positive relationship was found between the number of reported days using alcohol and the number of serious violent incidents reported ( $\beta = .28$ ;  $R^2 = .26$ ,  $p < .01$ ).<sup>3</sup> The number of days using marijuana and the number of days using other drugs, however, demonstrated no significant overall relationship to the frequency of serious violence in these analyses (data not reported). Thus, when the data are collapsed across time, individuals who reported more drinking days also reported a greater number of violent acts while in the community, but no such effect existed for the use of other substances.

Table 1 presents the probabilities of substance use and violence occurring on any given day along with the conditional probabilities of violence given substance use and vice versa. As seen in Table 1, the likelihood of serious violence on any given day of the follow-up period was only approximately 1.4%. The likelihood of serious violence increased on days when alcohol use only was reported (2.3%), as well as when alcohol in combination with other

substances was reported (4.4% to 9.0%).<sup>4</sup> Considering the data shown in Table 1 as odds ratios, participants were 1.7 times more likely to engage in serious violence on days that only alcohol was consumed and were 3.4 to 7.1 times more likely to engage in serious violence on days when multiple substances were used.<sup>5</sup> However, the probability of substance use also increased significantly on days in which individuals were violent. For example, individuals were about 2.5 times more likely to drink alcohol on days in which they had been involved in serious violence versus days where there was no serious violence reported.<sup>6</sup>

These findings are consistent with earlier cross-sectional studies that document the significant co-occurrence of substance use and violence. They substantiate that substance use is often associated with violent events the same day and provide some indication that substance using days, especially those with poly-substance use, are also violent days. They do not, however, specify whether the observed relationship is the result of a time-ordered, reciprocal, or spurious relationship, each of which has different explanatory and treatment implications. In the following section, we test the strength and ordering of the relationship between these variables 1 day apart.

### *Time-Ordered Relationship Between Substance Use and Violence*

Table 2 presents the odds ratios for the 1 day lag of violence, drinking, and drug use, with each of these behaviors on the subsequent day. The most striking aspect of this table is the serial nature of these behaviors: violence or reported substance use on any given day is highly predictive of the same behavior on the subsequent day. The odds ratios that characterize these relationships are shown in the diagonals of the tables. For example, a drug use day makes the likelihood of another drug use day about 30

<sup>3</sup> Similar results were obtained when "any violence" (either serious or minor violence) was used as the criterion.

<sup>4</sup> The mean probability for any type of violence, including both minor and serious forms was 3.9%. The increase in conditional probabilities on days when substances were reported was also found for any violence.

<sup>5</sup> These effects were also examined with a fixed-effects regression model. Fixed-effects regression methods focus on the within-person variation and control for unmeasured stable characteristics of participants. Allison (2005) argued that fixed-effects models provide some of the advantages of randomized experiments, because they control for unmeasured individual differences by using each individual as his or her own control. Fixed-effects odds ratios can be interpreted as the expected increase in the odds that a participant will engage in violence on a given day if he or she drinks or uses drugs that same day. Considering the data shown in Table 1 as fixed-effects odds ratios, the increase in the odds of violence on a day where alcohol only was consumed was not significant (odds ratio = 0.9, confidence interval = 0.6–1.5); however, on days on which multiple substances were used, the odds of violence still increased significantly from 3.0 to 6.7 times.

<sup>6</sup> With a fixed-effects model, individuals were 2 times more likely (confidence interval = 1.5–2.9) to drink alcohol on days during which they had been involved in serious violence versus days with no serious violence reported.

Table 2  
Odds Ratios for Substance Use and Serious Violence 1 Day Apart

Yesterday (T - 1)	Today (T)			
	Serious violence (CI)	Alcohol (CI)	Marijuana (CI)	Other drugs (CI)
Serious violence	5.4 (3.4–8.6)	1.9 (1.4–2.5)	1.5 (1.2–2.0)	2.1 (1.3–3.6)
Alcohol	2.4 (1.8–3.2)	9.5 (8.6–10.5)	2.1 (1.9–2.3)	2.8 (2.2–3.4)
Marijuana	1.6 (1.2–2.0)	2.3 (2.1–2.5)	31.5 (28.8–34.5)	1.5 (1.2–1.8)
Other drugs	1.5 (0.8–2.8)	2.2 (1.8–2.7)	1.5 (1.2–1.8)	48.1 (39.0–59.2)

Note. CI = confidence interval.

times to 50 times more likely.<sup>7</sup> Clearly, these behaviors occur in close proximity in the observed series. The tables also indicate the odds of violence increasing the day following substance use versus the odds of substance use the day after a violent incident, with no clear pattern regarding the relative strength of these relationships.

We also considered the effects of using multiple substances on a prior day. As seen in Table 2, violence was more likely to occur on the days when alcohol had been consumed the prior day (2.4 time more likely). Some of these “alcohol” days, however, were also days when alcohol was consumed with marijuana or other drugs. On days where only alcohol was consumed, individuals were 1.8 times more likely to engage in violence on the next day; however, participants were 4.1 times more likely to report involvement in violence the following day if alcohol, marijuana, and other drugs were used. Interestingly, if only alcohol and marijuana use was reported, the odds of violence the next day decreased to the point where they were no longer significant. The same finding held for the combined effect of marijuana and other drug use.<sup>8</sup>

*Structural model of the relationship.* Although the previous set of analyses provides evidence that reported behavior yesterday (engagement in violence or substance use) is a good predictor of the same behavior today, the question still remains whether substance use and violence are predictive of each other over time. In order to formally evaluate the relative strength of these estimates, a series of cross-lagged longitudinal models (structural equation models [SEMs]) were fit to the data. This approach is based on the early work of Jöreskog and colleagues (Jöreskog, 1970; Jöreskog & Sörbom, 1979) and has been applied widely within the psychological literature (Ferrer & McArdle, 2003; McArdle & Bell, 2000).

These SEM models provide direct empirical tests of the competing explanations of the association between substance use and violence through a simultaneous estimation of the possible relationships. Specifically, these models allow for an estimation of whether (a) substance use yesterday is related to violence today, after controlling for the lagged effects of violence on itself and the concurrent effects of substance use and/or (b) violence yesterday is related to substance use today, after controlling for the lagged effects of substance use on itself and the concurrent effects of violence. The models were fit with categorical and multi-level modeling options available in Mplus Version 3.13 (Muthén & Muthén, 2004) and were fit separately for each type of substance use (alcohol, marijuana, and other drugs).

The general framework of the models tested for each type of substance use is presented in Figure 1. All of the models allowed for an estimation of the concurrent relationship between that type of substance use and serious violence ( $c$ ), as well as two autoregressive parameters ( $\beta_1$ ,  $\beta_2$ ) that described the relationship between that type of substance use yesterday ( $T - 1$ ) and that type of substance use today ( $T$ ), as well as serious violence yesterday ( $T - 1$ ) and serious violence today ( $T$ ).<sup>9</sup> Three nested models were tested for each type of substance use. Model 1 provided a test of whether there was a reciprocal relationship between substance use and violence by estimating the cross-lagged relationships ( $\gamma_1$ ,  $\gamma_2$ ) between substance use yesterday ( $T - 1$ ) and serious violence today ( $T$ ) and violence yesterday ( $T - 1$ ) and substance use today ( $T$ ). Model 2 tested whether the effect of violence yesterday on substance use today was needed in the model by constraining  $\gamma_2 = 0$ . The final model tested whether the effect of substance use yesterday on violence today was needed in the model by constraining  $\gamma_1 = 0$ .

As demonstrated in Table 3, there was no reduction in fit when we moved to Model 2 and constrained the relationship between

<sup>7</sup> Using a fixed-effects model reduces this odds ratio to approximately 7–8 times more likely.

<sup>8</sup> The time-ordered relations reported above were also tested separately for male and female participants. In general, the pattern of results is the same across genders. The only exception appears to be that, on days during which alcohol and other drugs were used, there was a marked increase for violence among female participants but no increase for male participants. These results are available from the authors upon request.

<sup>9</sup> A structural autoregressive model was fit separately for violence and each type of substance use in order to determine the ideal number of lags. All substances were related to each other for at least three lags. Alcohol use at  $T - 3$  ( $\beta = .12$ ),  $T - 2$  ( $\beta = .14$ ), and  $T - 1$  ( $\beta = .67$ ) was related to alcohol use at Time  $T$ . Similarly, marijuana use was predictive of future marijuana use lagged by one ( $\beta = .88$ ) two ( $\beta = .44$ ) and three days ( $\beta = .32$ ), with a similar pattern for other drug use (Lag 1,  $\beta = .66$ ; Lag 2  $\beta = .33$ ; Lag 3,  $\beta = .15$ ). Serious violence, however, was not related to itself beyond a 1-day lag. All structural models were fit allowing for an autoregressive lag of 3 days for substance use and 1 day for serious violence; autoregressive lags beyond 1 day are not depicted in Figures 1 and 2 in order to simplify the presentation of the models. The clustering of occasions within individuals was accounted for through the use of a multi-level modeling framework.

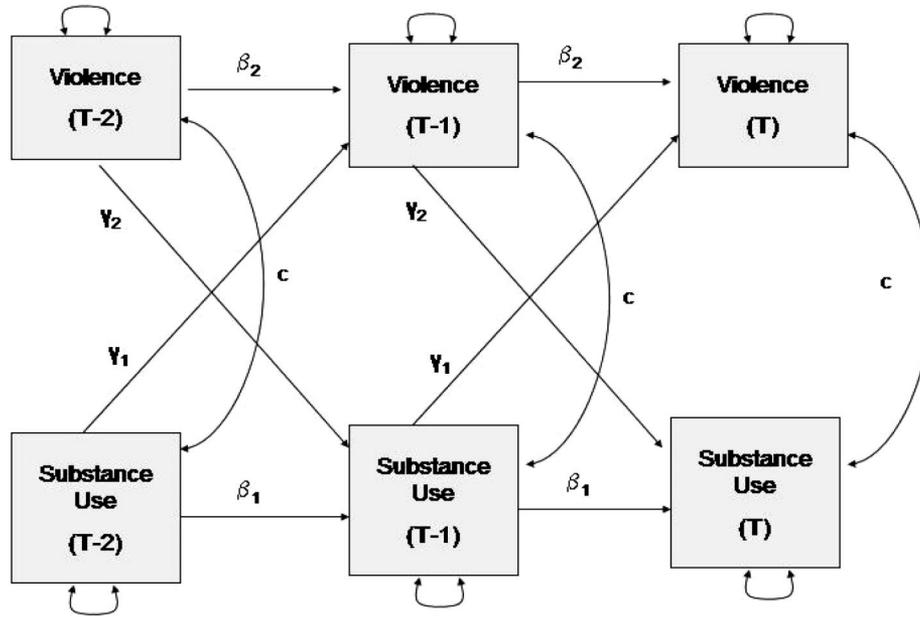


Figure 1. Cross-lagged time series structural equation model for testing the relationships among types of substance use and serious violence. T = today, T - 1 = yesterday; T - 2 = the day before yesterday;  $\gamma_1$  and  $\gamma_2$  represent the cross-lagged relationships;  $\beta_1$  and  $\beta_2$  represent autoregressive parameters; and c represents the concurrent relationship between the specific type of substance use and serious violence. See "Structural model of the relationship" section in text for further explanation.

violence yesterday and alcohol use today to be zero ( $\Delta\chi^2 = 1.4$ ,  $\Delta df = 1$ ; WRMR = 1.8, where WRMR = weighted root mean square residual). However, there was a loss in fit in Model 3, where we attempted to constrain the relationship between alcohol use yesterday and violence today to be zero ( $\Delta\chi^2 = 26.5$ ,  $\Delta df = 1$ ; WRMR = 2.8). These results provide support for a 1-day lagged effect of alcohol use on violence but do not support violence as a leading indicator of next-day alcohol use. When the same set of models was examined replacing alcohol use with marijuana and other drugs, there were no significant cross-lagged, 1-day relationships.

The statistically significant path coefficients obtained from the "best fitting" model (Model 2) are presented in Figure 2. As seen in this figure, alcohol use was predictive of violence the following day ( $\gamma_1 = .10$ ); however, violence was not predictive of alcohol use the following day. Consistent with the findings in Table 2, serious violence was related to next-day serious violence ( $\beta_2 = .34$ ), and alcohol use was related to alcohol use the following day ( $\beta_1 = .81$ ). Overall, the above analyses show no consistent indications that violence affected later alcohol use but did show indications that alcohol use affected subsequent violence. Conversely, these models do not provide support for a temporal relationship between violence and marijuana and/or violence and other drug use.<sup>10</sup>

## Discussion

This study provides a fine-grained view of the relationship between substance use and violence in a group of mentally ill individuals. It is important to remember from the outset, however,

that although the group of individuals followed here is of considerable policy interest, they are not representative of individuals with mental illness in general. Instead, these participants represent a subgroup of individuals in the mental health system who are at high risk for repeated involvement in violent incidents. Even in this rather homogeneous sample of substance-abusing individuals with histories of violence, however, variations in substance use were still significantly associated with violence. Perhaps more importantly, there was a temporal relationship between the use of alcohol, alone or in combination with drugs other than marijuana, and involvement in violence. In this section, we consider the study's primary findings, limitations, and implications.

### *Concurrent Relationship Between Substance Use and Violence*

The findings of this investigation agree with some earlier studies that used different approaches to examine the concurrent relationship of substance use and violence among individuals with mental illness (Monahan et al., 2001; Swartz et al., 1998). It is important to note, however, that the depiction of the strength of the relationship between substance use and involvement in violence can vary widely, depending on the samples used, the ways that these variables are operationalized, the time period examined, and the tests of association used. For example, in research using data from the

<sup>10</sup> These structural models were also run separately for male and female participants. There were no differences in the model fits by gender. Results are available from the authors upon request.

Table 3  
Fit Statistics for Lagged Time Series Models

Analysis	Model 1 A↔V	Model 2 A→V	Model 3 V→A
Autoregressions			
A(T - 1) → A(T) [ $\beta_1$ ]	0.81	0.81	0.82
V(T - 1) → V(T) [ $\beta_2$ ]	0.34	0.34	0.38
Cross-lagged regressions			
A(T - 1) → V(T) [ $\gamma_1$ ]	0.10	0.10	0.00
V(T - 1) → A(T) [ $\gamma_2$ ]	0.003 (ns)	0.00	-0.03 (ns)
Correlation			
A(T)↔V(T) [c]	0.21	0.21	0.28
Fit statistics			
CFI	0.99	0.99	0.96
WRMR	1.8	1.8	2.4
RMSEA	0.02	0.02	0.03
$\chi^2(df)$	79.7 (7)	81.1 (8)	106.2 (8)

Note. V = serious violence; A = alcohol use; CFI = comparative fit index; WRMR = weighted root mean square residual; RMSEA = root mean square error of approximation.  $\beta_1$  and  $\beta_2$  represent autoregressive parameters;  $\gamma_1$  and  $\gamma_2$  represent cross-lagged relationships; and c represents the concurrent relationship. See "Structural model of the relationship" section of the text for further explanation. All parameters are significantly different than 0 unless otherwise indicated (ns).

Epidemiological Catchment Area studies (Swanson et al., 1990), the presence of an alcohol or drug abuse disorder diagnosis increased the likelihood of reported involvement in violence 12- to 13-fold compared with the prevalence observed in the general population (about 2%). In a follow-up study of discharged patients, Steadman et al. (1998) found a substance abuse diagnosis roughly doubled the likelihood of reporting involvement in violence in a

sample of discharged patients over a 1-year period (from about 18% to about 40%). At some point, gauging the exact strength of the association between substance use problems and violence becomes a question of what one measures and what groups are compared.

In this study, the goal was not to determine how many cases report both substance use and violence. On the contrary, the sample for this study was chosen because both of these behaviors were already documented as present. The purpose was to examine how these two behaviors related to each other over time in this select sample.

Considering the entire follow-up period, however, individuals who drank or used other drugs more often had more involvement in violence. Moreover, at the daily level, it appears that use of alcohol and other drugs often co-occur regularly with violence; violent days are more likely to be substance-using days and substance-using days are more likely to be violent days (although this is less true of marijuana). These findings indicate that the relationships between substance use and violence observed in broader samples also hold in a group where these two behaviors occur relatively often and are strongly linked historically. Even in this high-risk, high-substance-abusing group, substance use that is frequent or involves multiple types of drugs is cause for some concern, given that such use may accompany violence. Although it is difficult, and potentially misleading, to compare the effect sizes of the association seen in this investigation with prior studies, it is notable that the overall association between level of substance use and violence appeared at all in this sample. This indicates that these two behaviors are linked rather strongly, even when measured in fine-grained fashion in a group with limited variability in these behaviors.

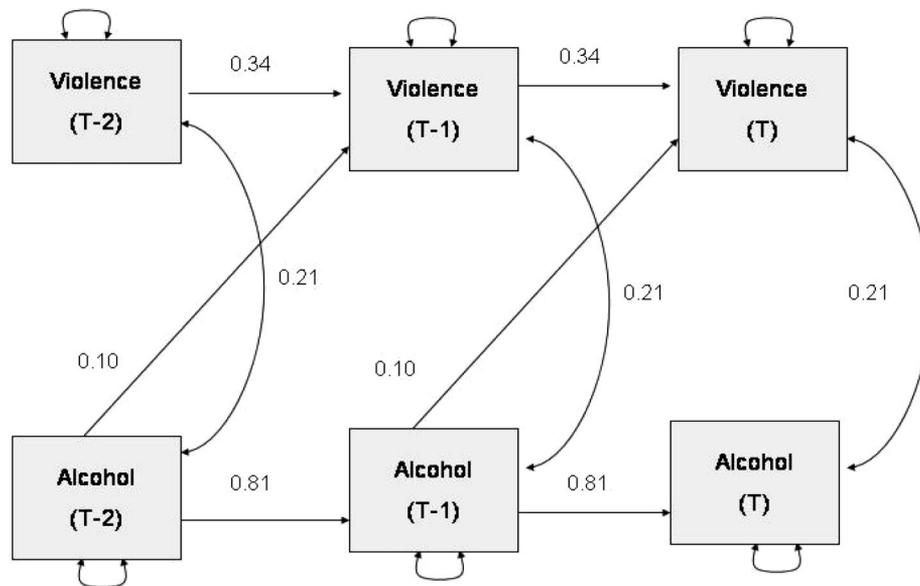


Figure 2. Cross-lagged time series model for alcohol and violence. T = today; T - 1 = yesterday; T - 2 = the day before yesterday. Note that 14% of the variance in violence today is accounted for by this model; that is, violence today is a product of violence yesterday ( $\beta_2 = .34$ ), alcohol use today ( $c = .21$ ), and alcohol use yesterday ( $\gamma_1 = .10$ ). See Figure 1 for identification of model paths.

### *Time-Ordered Relationships of Substance Use and Violence*

Time series models were used to provide a fuller picture of the nature of the relationship between substance use and violence over time. These models suggest that the relationship between some forms of substance use and violence is direct rather than reciprocal. Specifically, the models indicate that drinking predicts proximate violence, whereas violence does not predict proximate substance use of any kind. For this high-risk subgroup, drinking today significantly (if modestly) increases the risk of violence tomorrow. These models also provide further support for the increased risk of violence associated with using multiple substances.

### *Like Predicts Like: "Mini-Bursts" of Behavior*

Examining the complexities of the relationship of substance use and violence at the daily level should not lead us to ignore another basic finding of this investigation, that is, that the key behaviors examined in this study appear to occur in "bursts." The time series models provide clear evidence of the serial nature of these policy-relevant behaviors, with substance use on 1 day related to substance use on the next 2 days and violence on 1 day related to violence on the next day. People engage in substance use and violence for periods involving successive days, and the relations among these behaviors appear to predominantly reflect consistency of behavior within series over several days rather than a consistently strong association in which one form of substance use precipitates violence. This implies that we need to develop a fuller understanding of the patterns and effects of these extended periods of substance use for their impact on other aspects of functioning.

It also implies that we should attend to the consistency of violence as a predictor of subsequent violence at the daily level. Studies regarding the prediction of violence among those with mental illness have repeatedly shown that a history of violence is a powerful risk marker for later violence (Monahan et al., 2001). In the current study, this association between past violence and subsequent violence also emerged, but this time the association is within individuals over relatively short time periods. The results here indicate that not only do individuals with violent histories tend to repeat violent behaviors but that even in a group of repeatedly violent individuals, the occurrence of a violent incident indicates significantly increased risk for another violent event in the very proximate future (i.e., 1–2 days). A high-risk individual who is violent today is more likely to become involved in violence tomorrow relative to a high-risk individual who is not violent today.

### *Design Limitations*

The set of repeated measures obtained in this study permitted an assessment of the proximal effects of alcohol and drug use on violence, with minimal distortion associated with relatively long recall periods (Roberts, Mulvey, Horney, Arter, & Lewis, 2005). Nevertheless, the study also has clear limitations. Perhaps most notable is that the substance use and violence variables are based on self-report, and error may be present if participants were mo-

tivated to misreport. It may be that individuals either overreport or underreport involvement in either behavior (based on different normative judgments about desirable self-presentation), but the exact amount or type of bias introduced by the reliance on self-report is difficult to gauge accurately (cf. Lidz et al., in press). Future investigators may wish to use multiple methods of assessing substance abuse and violence.

It is also important to note that the overall pattern of results could be different with a lag period longer than 3 days. The 3-day lag period was chosen because it made theoretical and pragmatic sense. We found it difficult to posit a clear connection between substance use and violence using longer periods, given the increasing likelihood of intervening events as the lag period expanded. In addition, this period seemed likely to include most things likely to be identified in a clinical interview as a "precipitating event" for violence, and it was a reasonable period for a clinician to consider when assessing the likelihood of future violence on learning that an individual had been drinking on a particular day. Although the possibility exists that particular patterns of drinking or drug use over a longer period may be related to the occurrence of a violent incident, the conceptual basis for specifying these models was not readily apparent.

The pattern of results may also have been different, with a lag period shorter than 1 day. Our choice of a day as the unit of analysis was a practical decision based on what seemed reasonable with this sample over a long time period of repeated interviewing. Because we did not collect information about the ordering of substance use and violence on the same day, we are unable to disentangle the concurrent relationship (i.e., we do not know whether substance use consistently preceded violence when they co-occurred on a given day).

Our results are consistent with the position that intoxication, rather than generalized stress, increases the likelihood of violence, although this issue cannot be addressed definitively with these data. In investigations using similar methods with individuals with histories of domestic violence, Fals-Stewart, Golden, and Schumacher (2003) found a concurrent relationship between alcohol use and violence, with the relation between drinking and violence strongest shortly after alcohol consumption (Fals-Stewart, 2003). The pattern of findings here shows the same effect for concurrent alcohol use and violence, with the reduction in effect size probably the result of sampling differences.

Our findings (as well as those of Fals-Stewart's group) do show evidence that drinking 1 day prior is related to violence and that drug use 1 day prior is not. This points up the possibility that the social consequences of drinking may ripple beyond the immediate intoxication effect as well, or that unstable social relationships may cause both behaviors. These latter possibilities can only be addressed using an experimental design. In addition, it is reasonable to posit that these mechanisms may not hold equally for all types of violent individuals. Involvement in certain types of violence (e.g., more or less severe or more or less frequent) may be moderated by certain characteristics that interact with substance use. Recent work, for instance, shows that antisocial personality disorder appears to play such a role in the effect of alcohol on more and less severe forms of domestic violence (Fals-Stewart, Leonard, & Birchler, 2005).

### Implications for Intervention and Future Research

The results of this study have specific implications for assessing, monitoring, and reducing the violence potential of high-risk patients. The findings indicate that an individual's frequency of drinking is a sound risk marker for violence over an extended period; individuals who drink more heavily over several months are also more likely to engage in more violence over that time period. Thus, instruments or clinicians attempting to identify individuals likely to be violent over some specified, extended time (in this study, 6 months) would do well to consider overall level of drinking in their calculation of risk.

These results also indicate that a clinician attempting to manage violent patients would do well to monitor an identified high-risk patient's patterns of drinking, particularly when they coincide with use of multiple drugs. Drinking is a proximate precursor of involvement in violence in high-risk individuals such as those followed here, and use of multiple substances also increases the risk of violence in the near future. Clinicians monitoring high-risk patients should be attuned to the increased likelihood of imminent violence (within the next day) when alcohol use or multiple drug use is reported. There appears to be no indication of increased risk of violence with marijuana use alone. At the same time, the strength of the proximate relationship between substance use and violence was statistically significant, but relatively weak (except for multiple drug use). There was still a large amount of violence in the lives of these individuals that did not occur directly proximate to drinking or use of other drugs.

The most remarkable aspect of these findings is that they hold in this restricted set of high-risk individuals with significant histories of substance use and violence. Because of the selectivity of the sample, these findings are not generalizable to individuals with a particular diagnostic profile, all substance-using individuals, or even all individuals who appear in a psychiatric emergency room. The sampling method used here produced a refined group of individuals who appeared at a psychiatric emergency room, chosen with a structured algorithm for their high likelihood of frequent involvement in violence. It also excluded individuals with a current diagnosis of a psychotic disorder, and the effects of these disorders and their potential interactions with substance use could not be assessed effectively here. Whether a broader sample of individuals with mental illness, or a sample of non-mentally ill individuals or a sample of more ethnically diverse individuals using a wider range of substances (e.g., methamphetamine) would show the same clustering of behaviors and relation between substance use and violence is an open question. In this group of high-risk individuals, however, these relations are strong enough to deserve attention.

Finally, these findings are generally consistent with formulations of substance use acting primarily as a disinhibitory agent related to violence or being a component of situations where violence is most likely to occur. The concurrent relationships of substance use and violence are strong in these data, but there is little indication of a build-up to violence from several days of substance use. Although this study could not map out the relationship of substance use at the daily level, it could effectively test for the presence of an extended period of either alcohol or drug use leading up to a violent incident. This type of clinical picture seems only to apply to alcohol use, and then only within a rather short

time window (with use on 1 day increasing the likelihood of violence the next). Researchers still have a formidable task to disentangle the many intersecting factors needed to short-circuit the connection between substance use and violence.

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