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Predicting Post Treatment-Initiation Alcohol Use Among Patients With Severe Mental Illness and Alcohol Use Disorders

Clara M. Bradizza,

Research Institute on Addictions, University at Buffalo

Stephen A. Maisto,

Department of Psychology, Syracuse University

Paula C. Vincent,

Research Institute on Addictions, University at Buffalo

Paul R. Stasiewicz,

Research Institute on Addictions, University at Buffalo

Gerard J. Connors, and

Research Institute on Addictions, University at Buffalo

Nicole D. Mercer

Research Institute on Addictions, University at Buffalo

Abstract

Few studies examining alcohol abuse among individuals with a severe mental illness (SMI) have examined predictors of post-treatment alcohol outcomes. The present study uses a multivariate approach based on a theoretical model to study the relationship between psychosocial factors and post treatment-initiation alcohol use. Predictors of alcohol use outcomes were examined in 278 individuals diagnosed with a current DSM-IV schizophrenia-spectrum or bipolar disorder and an alcohol use disorder (AUD). At 6-months follow-up after initiating treatment, 144 of 228 available participants (63%) had good clinical outcomes. The results of structural equation modeling indicated that type of pretreatment residential setting was directly related to treatment with participants living in supervised settings (41%) reporting significantly more days of treatment ($\beta = .34, p < .001$). In addition, participants with more psychiatric symptoms, assessed by the Brief Symptom Inventory and Structured Clinical Interview for the Positive and Negative Syndrome Scale, reported significantly fewer treatment days ($\beta = -.20, p < .001$). Number of days participants attended treatment was indirectly associated with alcohol use outcomes and was mediated by use of alcohol coping skills, such that more frequent use of alcohol-specific coping skills was associated with less post treatment-initiation alcohol use ($\beta = -.34, p < .001$). This study emphasizes the favorable prognosis for alcohol outcomes among **treated** individuals with a SMI and AUD and the importance of psychosocial interventions, particularly those that result in better alcohol-specific coping skills.

Correspondence concerning this article should be addressed to Clara M. Bradizza, Research Institute on Addictions, University at Buffalo, 1021 Main Street, Buffalo, NY 14203-1016. bradizza@ria.buffalo.edu.

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Keywords

severe mental illness; alcohol outcome; schizophrenia; bipolar disorder; dual diagnosis

Introduction

Individuals with a severe mental illness (SMI; i.e., schizophrenia, bipolar disorder) and a substance use disorder (SUD) incur significantly more negative consequences as compared with SMI individuals with no SUD including more severe psychiatric symptoms (Carey, Carey, & Meisler, 1991), more frequent psychiatric re-hospitalizations (Drake, Osher, & Wallach, 1989), less stable living situations (Drake & Wallach, 1989), fewer regular meals and activities (Drake & Wallach, 1989), and greater rates of violent behavior (Cuffel, Shumway, Chouljian, & MacDonald, 1994).

Rates of relapse to alcohol use among SMI individuals following treatment are high. Studies assessing alcohol outcomes among samples of non-SMI individuals have noted relapse rates at 6 months post-treatment of approximately 50-80% and at 12 months of 70-80% (Hunt, Barnett & Branch, 1971; Lowman, Allen, Stout and the Relapse Research Group, 1996). Among SMI individuals, studies providing group and/or individual treatment have found rates of return to post-treatment alcohol and drug use are similarly high (e.g., Baker et al., 2006; Graeber, Moyers, Griffith, Guajardo, & Tonigan, 2003; Hellerstein, Rosenthal & Miner, 2001; Kavanagh et al., 2004; Meisler, Blankertz, Santos, & McKay, 1997; Xie, McHugo, Drake and Sengupta, 2003; Weiss et al., 2007). For example, Graeber and colleagues (2003) randomly assigned 30 individuals diagnosed with a schizophrenia-spectrum and an AUD to receive three individual sessions of either: (1) a motivational intervention (MI) or (2) an educational treatment (ET). Results at 6-months follow-up indicated that 60% of the MI group and 100% of the ET had relapsed to alcohol use during the study period. Baker and colleagues (2006) randomly assigned 130 individuals diagnosed with a psychotic disorder and a SUD who were recruited from inpatient and outpatient treatment sites to ten individual sessions of either a motivational intervention with cognitive behavioral therapy (MI+CBT) or the provision of a self-help booklet and treatment-as-usual (control). At 12-months post-treatment, 86% of the MI+CBT group and 81% of the control group had relapsed to alcohol use. A recent review of psychosocial interventions for individuals with a SMI and SUD concluded that interventions that have shown promise with this population seem to have common elements including skill-building, education and peer support components (Drake, O'Neal, & Wallach, 2008).

Treatments that have emphasized skills-based interventions have demonstrated a modest impact on substance use outcomes. Shaner and colleagues examined the feasibility and acceptability of providing an alcohol and drug coping skills treatment to 56 SMI-SUD individuals recruited from a dual diagnosis day treatment program (Shaner, Eckman, Roberts, and Fuller, 2003). Participants reported good treatment satisfaction ratings and significantly fewer days of drug use following treatment as compared to pre-treatment. However, the absence of a control group precludes determination of whether treatment gains were due to the treatment as opposed to other extra-treatment factors. Bellack, Bennett, Gearon, Brown, and Yang (2006) randomly assigned 175 individuals diagnosed with a SMI and a drug use disorder to six months of either a behaviorally-focused intervention (BTSAS) or a control supportive treatment; however, difficulties with treatment engagement reduced the sample analyzed to 110 individuals. Individuals in the BTSAS group received contingent reinforcement for abstinence from drug use as well as motivational interviewing, and training in social and coping skills. At post-treatment, the BTSAS group had fewer drug-positive urines, longer periods of continuous abstinence, and lower rates of treatment dropout. No group differences were found on self-reported number of days of abstinence or days with drug problems. No data on

concurrent alcohol use or problems were reported. Given the absence of follow-up data, it is unclear if the improvement observed in the BTSAS group would be maintained following the post-treatment interview. These studies indicate the need for engaging and effective treatments for substance abuse in this difficult to treat population (Drake, Wallach, & McGovern, 2005). However, designing effective alcohol treatments for SMI individuals requires knowledge of factors that influence post treatment-initiation functioning and a theoretical framework for conducting research studies.

A social-cognitive approach to understanding post treatment-initiation alcohol use views coping skills and self-efficacy as essential constructs influencing alcohol outcomes. Coping skills are critical to managing stressful events and alcohol problems are believed to result, in part, from deficits in coping with difficult situations (Bandura, 1969). Self-efficacy is the confidence one has in abstaining from alcohol (DiClemente, Carbonari, Montgomery, & Hughes, 1994) or not drinking heavily (Annis & Davis, 1988) in a given situation. The empirical literature on skills-based approaches has emphasized the effectiveness of coping skills interventions and the impact of improving self-efficacy in the treatment of alcohol use disorders. In general, individuals with better alcohol-specific coping skills and greater self-efficacy to manage high-risk drinking situations have better post-treatment alcohol outcomes (e.g., Donovan, 1996; Kadden, 2003; Maisto, Zywiak, & Connors, 2006; McKay & Weiss, 2001; Monti et al., 1990; Monti et al., 1993; Sitharthan & Kavanagh, 1990; Solomon & Annis, 1990). Despite this support for skills-based approaches among non-SMI substance abusers, little research exists examining coping skills and self-efficacy among SMI-SUD individuals. Moggi and colleagues (1999) examined the influence of general and substance-specific coping on alcohol and drug outcomes among 981 male patients with an SUD and a co-morbid psychiatric disorder. The sample included 142 individuals diagnosed with an SUD and a psychotic disorder. Among this sub-sample, better skills in both types of coping situations were associated with greater abstinence at one year post-treatment.

The proposed model for understanding alcohol outcomes among SMI individuals holds promise for integrating currently available data and provides a theoretical framework for studying the relationship between psychosocial factors and post-treatment alcohol use using a multivariate approach. Moos and colleagues (Moos & Finney, 1983; Moos, Finney, & Cronkite, 1990) have proposed a systems model that incorporates variables assessing related constructs that are grouped conceptually into factors allowing for the exploration of complex interrelationships among factors and alcohol outcomes. Studies conducted over the past 20 years with non-SMI SUD individuals support this model (e.g., Connors, Maisto, & Zywiak, 1996, 1998; Moos et al., 1990). The model tested in our study was adapted from the work of Cronkite and Moos (1980) and Connors et al., (1996) for research with SMI individuals by conceptualizing psychiatric symptoms as a separate factor, rather than incorporating these symptoms into the Background Characteristics factor, as was done by Cronkite and Moos, and Connors and colleagues. In addition, we separated Coping Skills and Self-efficacy into separate factors, given our interest in these variables as potential mediators of treatment effects. Our model (see Figure 1) proposes that several different factors may affect alcohol use following treatment initiation or completion. These factors vary in proximity to alcohol use outcome and represent the interrelationships among these factors over time. These include Background Characteristics (e.g., age, gender, residential setting), Psychiatric Symptomatology (e.g., symptoms of schizophrenia, anxiety, and depression), Pre-treatment Alcohol Use and Related Problems (e.g., quantity and frequency of alcohol use and problems), Treatment (e.g., formal treatment and self-help group attendance), Coping Skills (i.e., alcohol-specific), Self-efficacy (e.g., confidence in remaining abstinent from alcohol), and Alcohol Use Outcomes (e.g., quantity and frequency of alcohol use). Background Characteristics (X_1), Psychiatric Symptomatology (X_2), and Alcohol Use and Related Problems (X_3) have direct paths to Treatment (X_4), as these factors influence type and amount of treatment. The direct paths

between X_1 , X_2 , X_3 and the outcome variable X_7 (Alcohol Use) reflect the consistent findings among individuals with an AUD and no SMI of significant correlations between baseline client demographic, psychiatric, and alcohol-related variables, and alcohol-related outcomes. The Treatment variable (X_4) includes both psychiatric and substance abuse treatment and directly influences Alcohol Use (X_7) but also indirectly influences X_7 through the acquisition of coping skills (X_5) and abstinence self-efficacy (X_6).

The purpose of this study was to test the model presented in Figure 1 in a sample of SMI-AUD individuals who were followed for six months after initiating dual-diagnosis treatment (i.e., post treatment-initiation). This study is unique as it is the first known longitudinal study to investigate the interrelationships among client, treatment, and post treatment-initiation factors on alcohol outcomes among SMI individuals.

Method

Participants

Participants were 278 men and women seeking outpatient dual-diagnosis treatment from a community mental health center in Buffalo, NY that provides integrated mental health and substance abuse services. Group treatment includes topics such as the nature of dual disorders, changing negative thinking, overcoming denial of substance use problems, coping with negative emotions, relapse prevention, coping with craving, and introduction to 12-step groups. Individual appointments focus on coping with relapse, substance abuse education, social services and housing, and dealing with social stressors. The treatment program provides psychiatric services including pharmacotherapy for psychiatric disorders. Prior to program admission, all patients are sufficiently medically and psychiatrically stabilized such that they can participate in individual and group treatments (i.e., no longer in acute substance withdrawal or actively delusional). In addition, they receive a psychiatric consultation at the time of admission and prescribed medications are monitored by a psychiatrist. Although there are no strict rules or guidelines regarding length of treatment at the dual-diagnosis treatment program, the average length of treatment for the most recent calendar year (2007-2008) was 15.1 weeks. The current sample was 54% female and 46% male, with a mean age of 39.40 years ($SD = 8.35$) and a mean of 11.64 years of education ($SD = 1.86$). Ethnicity was African American (65%), Caucasian (27%), Latino (4%), Native American (3%), and other (1%). The sample was mostly single (97%), unemployed (98%), and low income (85% reported annual incomes less than \$10,000). At the baseline assessment, 41% lived in supervised settings (e.g., group home, halfway house) and 59% in unsupervised settings (e.g., apartment, private home). On average, participants had been treated (inpatient, residential or day, outpatient) 8.19 ($SD = 13.42$; $Mdn = 4.00$) prior times for psychiatric problems and 14.04 ($SD = 14.06$, $Mdn = 10.00$) prior times (detox, inpatient, residential or day, halfway house or group home, outpatient) for problems related to substance use.

Prior to the baseline assessment, potential participants took part in an initial diagnostic screening session to determine if they met the inclusion criteria. Participants were eligible if they had lived at their current address for at least six months *or* could provide contact information for two individuals (locators) who could be used to contact the participant during the study (i.e., stability criteria), scored at least 23 on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975), and met DSM-IV criteria for a current (i.e., past 12 months) AUD and a current (i.e., past 30 days) schizophrenia-spectrum and/or bipolar disorder based on the Diagnostic Interview Schedule for DSM-IV (DIS-IV; Robins, Cottler, Bucholz, & Compton, 1995). Nearly all (97%) met criteria for current alcohol dependence, while 3% ($n = 9$) met criteria for current alcohol abuse. The sample had high rates of current DSM-IV drug use disorders with 76% meeting criteria for cocaine abuse or dependence, 46% marijuana, 23% opiate, 16% sedative/hypnotic, and 9% amphetamine. Overall, 86% of participants met

criteria for at least one drug abuse or dependence diagnosis. Regarding comorbid mental disorders, 12% of participants met DSM-IV criteria for schizophrenia, 56% for bipolar and 32% for schizoaffective disorder.

Procedure

Individuals were approached during the first two weeks following treatment admission to participate in a six-month, naturalistic, longitudinal study examining predictors of relapse to alcohol and drug use. This study was approved by the University at Buffalo's Institutional Review Board and all participants provided written informed consent at which time they were assured of the confidentiality of their responses. Figure 2 depicts a study participant flow diagram using STROBE criteria (Egger, Juni, Bartlett et al., 1996; von Elm, Altman, Egger et al., 2008). Of 519 individuals assessed for eligibility, 224 (43%) were ineligible for the study because they did not meet the inclusion criteria: 199 did not meet DSM-IV diagnostic criteria, 20 did not meet the MMSE criteria, and 5 did not meet the stability criteria. Therefore, 295 (57%) met all study eligibility criteria. A small number of those eligible either refused to participate prior to the baseline interview ($n = 1$) or did not attend the baseline interview ($n = 16$), despite repeated scheduling attempts. Thus, a total of 278 participants completed the baseline interview and 224 (81%) were followed for the entire 6-month follow-up period. Eligible participants were contacted at monthly intervals for six months following the baseline assessment. In-person interviews were conducted at baseline and the 2-, 4-, and 6-month follow-ups. The 1-, 3-, and 5-month interviews were conducted by phone. The 6-month follow-up rate was 81%. Prior to each in-person interview, breath tests ensured that participants' blood alcohol level (BAL) was zero; those with a positive BAL were rescheduled. Due to limited reading ability among SMI participants, research interviewers read all questions to participants and recorded responses. Participants received retail gift cards as compensation for their participation.

Measures

Demographics and background information—At the diagnostic session, demographic information, current status (e.g., marital, employment, residential), and treatment history (e.g., psychiatric and substance abuse) were obtained.

Substance use and psychiatric diagnoses—The *Diagnostic Interview Schedule-IV* (DIS-IV; Robins et al., 1995) is a structured interview used to obtain current and lifetime DSM-IV Axis I diagnoses. The following sections of the DIS-IV were administered by a trained research interviewer to all participants: alcohol use, drug use, depression, mania, and schizophrenia.

Psychiatric symptoms—At the in-person interviews, participants completed two measures of psychiatric symptoms. The Structured Clinical Interview for the Positive and Negative Syndrome Scale (SCI-PANSS; Kay, Opler, & Fiszbein, 1992) is a 30-item measure of positive (i.e., productive) and negative (i.e., deficit) symptoms of schizophrenia. Portions of the interview were administered and videotaped by trained research assistants and later scored by research staff who were trained and supervised by the first author. Each symptom was scored on a 7-point scale (1 = *Absent*, 7 = *Extreme*), and items were summed for scoring. In our analyses, we used the 7-item Positive Symptoms (e.g., hallucinations, delusions, hostility) scale. A subset of 56 (21%) interviews were randomly selected and rated by a second, blind rater for purposes of interrater reliability. Based on Shrout and Fleiss's formula (Shrout & Fleiss, 1979), interrater reliability ($ICC = .84$) for this scale was excellent. Purnine, Carey, Maisto, and Carey (2000) found support for the validity of the positive symptoms scale in a SMI-SUD population. The second measure was the *Brief Symptom Inventory* (BSI; Derogatis, 1993), a measure of psychological symptoms. Responses to the BSI were made on a 5-point

scale (0 = *Not at all*, 4 = *Extremely*). The Depression (6 items) and Anxiety (6 items) scales were averaged to create an index of negative affect ($\alpha = .92$). The 5-item Paranoid Ideation scale (5 items; $\alpha = .79$) was also used.

Self-efficacy—At the in-person interviews, participants completed a modified version of the 50-item Drug Taking Confidence Questionnaire for alcohol (DTCQ; Sklar, Annis, & Turner, 1997). The DTCQ consists of eight subscales in which participants rate their confidence in resisting heavy drinking in various situations. To facilitate participants' understanding of the response scale, we simplified the instructions to read "How confident are you that you would not drink in each of these situations?" and substituted a 5-point Likert scale (1 = *Definitely would drink*, 5 = *Definitely would not drink*) for the original response scale. We renamed our modified version of the DTCQ the Alcohol Abstinence Confidence Questionnaire (AACQ). Due to high intercorrelations (avg. $r > .80$ at baseline) among the eight AACQ subscales, we used the total score as a measured variable in analyses ($\alpha = .98$ at baseline; $\alpha = .99$ at follow-up Month 6).

Coping Skills—At all in-person interviews, alcohol-specific coping was assessed with the Coping Behaviors Inventory (CBI; Litman, Stapleton, Oppenheim, & Peleg, 1983; Litman, Stapleton, Oppenheim, Peleg, & Jackson, 1984), a 36-item measure of coping strategies used to avoid relapse grouped into 4 subscales: positive thinking (e.g., "*Recognizing that life is no bed of roses but drinking is not the answer*"), negative thinking (e.g., "*Remembering how it has affected my family*"), avoidance (e.g., "*Forcing myself to go to work*"), and seeking social support (e.g., "*Going to an AA meeting*"). Participants were instructed to rate on a 4-point scale (0 = *Never*, 3 = *Usually*) how frequently they have used each strategy in the past 12 months (baseline interview) or past 2 months (follow-up interviews). Cronbach's alphas indicated good internal consistency at the baseline assessment for the positive thinking (.92) and negative thinking (.85) scales and fair internal consistency for the avoidance (.70) and seeking social support (.69) scales.

Participant alcohol use—Alcohol use during the 2 months prior to the baseline interview and the 6-month follow-up was assessed with the *Timeline Follow-Back* (TLFB; Sobell & Sobell, 1992). All TLFB variables were adjusted for time spent in a controlled environment (i.e., jail, hospital). The TLFB is reliable and valid among psychiatric outpatients (Carey, 1997). Three summary variables were used: number of drinking days, number of heavy drinking days, and drinks per drinking day. A heavy drinking day was defined as ≥ 4 drinks/day for women and ≥ 5 drinks/day for men. To assess problems related to alcohol use, we used the *Drinker Inventory of Consequences* (DrInC; Miller, Tonigan, & Longabaugh, 1995), a 50-item measure of adverse consequences of alcohol abuse. Participants were instructed to rate on a 4-point scale (0 = *Never*, 3 = *Daily or Almost Daily*) how frequently they had experienced each event (e.g., "*My family or friends have worried or complained about my drinking or drug use*") in the past 2 months (follow-up interviews).

We created a composite clinical outcome measure integrating alcohol use (TLFB) and negative alcohol-related consequences (DrInC). Following procedures developed for use in Project MATCH (e.g., Cisler & Zweben, 1999; Donovan et al., 2008; Zweben & Cisler, 2003), we determined which participants were "good clinical responders" during follow-up months 5 and 6 (i.e., completely abstinent or moderate drinkers with none or infrequent problems). Poor clinical outcomes were defined as heavy drinking or problems or heavy drinking and problems.

Participant treatment utilization—For each day, participants reported the number of hours they attended (1) formal treatment, and (2) self-help groups for alcohol, drug or mental health issues (e.g., AA, NA, Double Trouble) on the TLFB. The treatment utilization variable used

in analyses was the number of days participants attended *any* treatment (i.e., formal outpatient and/or self-help group) during the first four months of follow-up.

Results

Preliminary Analyses

In preliminary analyses, post treatment-initiation (follow-up months 5 & 6) alcohol use was examined by mental disorder diagnosis. Participants were categorized based on a current diagnosis of: (1) a schizophrenia-spectrum disorder and no bipolar disorder, (2) a bipolar disorder and no schizophrenia-spectrum disorder, or (3) schizoaffective disorder. There were no statistically significant differences among groups in post treatment-initiation alcohol use; therefore, analyses focused on the total sample of 278 enrolled participants. At follow-up months 5 & 6, 63% of participants (based on $n = 228$) had good clinical outcomes (i.e., completely abstinent or moderate drinkers with none or infrequent problems) and 37% had poor clinical outcomes (i.e., heavy drinking *or* problems *or* heavy drinking and problems).

Descriptive Statistics—The mean and standard deviation for each psychosocial, treatment, and alcohol use measured variable assessed at the baseline interview and used in the SEM analyses are shown in Table 1. A table of correlations among psychosocial, treatment utilization, and alcohol use measured variables is available from the first author upon request.

Data Screening—Prior to analyses, the univariate distributions of all continuous model variables were screened to identify outliers and determine if variable transformations were needed. Univariate outliers were screened by examining cases with standardized (z) scores greater than 3.29 ($p < .001$, two-tailed; Tabachnick & Fidell, 2001). Following outlier detection, these same model variables were screened for normality. The number of any treatment days variable was significantly kurtotic; therefore, it was square-root transformed. Due to significant skew and kurtosis, the number of drinking days variable (at baseline and follow-up months 5 & 6) was square-root transformed and the number of heavy drinking days and drinks per drinking day variables (at baseline and follow-up) were common log-transformed. In preliminary analyses, multivariate normality was assessed using Mardia's coefficient of multivariate kurtosis. Mardia's coefficient was 4.65 (std. estimate), indicating no serious departure from multivariate normality for these data.

Missing Data—Assessment completion rates for the 278 participants enrolled at baseline were as follows: 238 (86%) at month 1, 202 (73%) at month 2, 216 (78%) at month 3, 198 (71%) at month 4, 206 (74%) at month 5, and 224 (81%) at month 6. The Full Information Maximum Likelihood (FIML) algorithm was used for missing data; therefore, our analysis sample size was 278 for SEM analyses. This method is superior to conventional missing data methods such as listwise deletion (Allison, 2002).

Structural Equation Modeling

Overview—We used structural equation modeling (SEM) to test our model-based hypotheses. SEM analyses were conducted using the two-step approach (Anderson & Gerbing, 1988). In this approach, the first step is to test a measurement model (i.e., the relationships of measured variables to hypothesized latent variables) using confirmatory factor analysis (CFA). Given the likelihood that repeated measures over time will have correlated errors, we added covariances between observed variable residuals where appropriate (Cole & Maxwell, 2003). Tests of measurement (factorial) invariance also were conducted to determine whether the relation of the latent variables to their indicators was constant over time (Cole & Maxwell, 2003). All exogenous model variables covaried. Once adequate fit of the measurement model

was established, the second step was to test the structural model (i.e., hypothesized relationships among model variables).

Both the measurement and structural models were tested using Mplus version 5.0 (Muthén & Muthén, 2007) with FIML estimation. Models were determined to have acceptable fit if the standardized root mean square residual (SRMR) was $< .08$, the root-mean-square error of approximation (RMSEA) was $\leq .06$, and the comparative fit index (CFI) was $\geq .95$ (with CFI $\geq .90$ the conventional rule of thumb for adequate fit; Bentler & Bonett, 1980, Hu & Bentler, 1995). We also provide the 90% confidence intervals (CIs) for the RMSEA. Effect size was measured by R^2 for criterion variables, with large effects defined as $R^2 > .25$ (Hu & Bentler, 1998). Modification indices (MIs) were examined in order to determine whether additional parameters would improve model fit. The statistical significance of factor loadings and structural coefficients were determined by univariate z tests on unstandardized coefficients (critical value = 1.96, two-tailed; Muthén & Muthén, 1998-2007). In Mplus, standard errors for indirect effects were calculated using the Delta method (MacKinnon, Lockwood, & Williams, 2004). Within the text, we also report 95% symmetric confidence intervals (CIs) for standardized parameter estimates (i.e., structural coefficients).

In preliminary analyses examining correlations between demographic variables and post treatment-initiation alcohol use, gender, type of residential setting, and age began drinking were significantly associated with post treatment-initiation alcohol use. Therefore, these three measured variables were included in the model as covariates. Self-efficacy (baseline and follow-up month 6)¹ and treatment utilization (number of days of outpatient and/or self-help group attendance during follow-up months 1-4) also were measured variables in the model. Baseline psychiatric symptoms formed a latent variable with three indicators: BSI paranoid ideation, BSI negative affect (depression/anxiety), and the PANSS positive symptom scales. Coping skills (baseline and follow-up month 4) formed a latent variable with four indicators based on the four CBI scales. Finally, alcohol use (baseline and follow-up months 5 & 6) was a latent variable with three indicators derived from the TLFB data: number of drinking days, number of heavy drinking days, and drinks per drinking day. As illustrated in our hypothesized model (see Figure 3), we used prospective data to (1) include controls for prior levels of dependent variables, and (2) maintain the hypothesized temporal relations among predictor, mediator and criterion variables (Cole & Maxwell, 2003; Witkiewitz & Marlatt, 2008). Particular assessment points (i.e., treatment utilization during Months 1-4, coping skills at Month 4, and self-efficacy at Month 6) were chosen to maintain the hypothesized temporal order among model variables. In this way, our analyses reflect a rigorous test of whether treatment effects are mediated by coping skills.

Test of the Measurement Model—Using CFA, we determined the fit of the measurement model (with all latent factors estimated in the same model, using the indicators described above) was acceptable: $\chi^2 = 358.09$ ($df = 174$), $p < .001$; SRMR = .06, RMSEA = .06 (90% CI = .05, .07); CFI = .94. Table 2 presents the standardized factor loadings. As shown in this table, nearly all of the loadings were large (.62 to .98), with only one loading in the moderate range ($< .60$). All loadings tested were statistically significant ($p < .001$), demonstrating reliable indicators.

Next, we evaluated whether the measurement model was consistent over time. Specifically, measurement invariance across time was evaluated for the coping skills (baseline vs. follow-up month 4) and alcohol use (baseline vs. follow-up months 5 & 6) factors. We first estimated a model with all factor loadings allowed to vary freely (baseline model). Next, we estimated a model with all factor loadings constrained to be equal. A chi-square difference test for the two models was used to determine measurement invariance across time.

¹Prior to SEM analyses, AACQ total scores were rescaled by multiplying by .10.

We found evidence for partial measurement invariance for coping skills, with time invariance for all factor loadings except avoidance. We found evidence for partial measurement invariance for alcohol use, with time invariance for all factor loadings except one. Evidence for measurement invariance across time was deemed sufficient and considered unlikely to threaten the interpretation of the longitudinal findings (cf. Cole & Maxwell, 2003).

Test of the Structural Model—The next step was to test the structural model (see Figure 3) and the analyses showed that fit of the structural model was adequate: $\chi^2 = 399.40$ (df = 193), $p < .001$; SRMR = .07, RMSEA = .06 (90% CI = .05, .07); CFI = .93. Modification indices were trivially small relative to the model chi-square (all MIs ≤ 31); therefore, no *post hoc* model modifications were considered. Figure 4 presents results for the final structural model.² Significant ($p < .05$) correlations among exogenous variables were: gender (coded 0 = male, 1 = female) with age began drinking ($r = .12$) and baseline self-efficacy ($r = .15$); type of residential setting (coded 0 = unsupervised, 1 = supervised) with baseline coping skills ($r = .12$); age began drinking with baseline coping skills ($r = .20$); baseline self-efficacy with baseline psychiatric symptoms ($r = -.44$), baseline coping skills ($r = .42$), and baseline alcohol use ($r = -.30$); baseline psychiatric symptoms with baseline coping skills ($r = -.21$) and baseline alcohol use ($r = .20$); and baseline coping skills with baseline alcohol use ($r = -.30$).

As shown in Figure 4, the results indicated fairly strong, statistically significant stability coefficients (i.e., autoregressive effects) for self-efficacy ($\beta = .47$, $p < .001$) and coping skills ($\beta = .42$, $p < .001$) over the course of six months. However, the stability coefficient for alcohol use ($\beta = .11$, $p = .07$) was low, indicating that alcohol use was less stable between baseline and follow-up. Baseline residential setting showed a fairly strong, direct relationship to treatment, with participants who lived in supervised settings reporting more treatment. Baseline residential setting also was weakly associated with follow-up alcohol use, with participants in unsupervised settings reporting greater post treatment-initiation alcohol use. As expected, participants' psychiatric symptoms were directly associated with treatment, with fewer psychiatric symptoms associated with attending more treatment. Contrary to our expectations, however, baseline alcohol use was not directly associated with subsequent treatment. Interestingly, neither baseline psychiatric symptoms nor treatment utilization were directly associated with post treatment-initiation alcohol use. Rather, both variables were indirectly associated with alcohol use through coping skills. Specifically, participants with fewer initial psychiatric symptoms reported more treatment. In turn, more treatment was related to more frequent coping. Finally, as hypothesized, more frequent coping and self-efficacy were directly associated with less post treatment-initiation alcohol use. In addition, coping skills were directly related to self-efficacy, although this association was at the trend-level. Together, the variables in the model explained 30% of the variance in coping skills at Month 4 and 35% of the variance in alcohol use at follow-up months 5 & 6.

Coping Skills as a Mediator—As hypothesized, the effect of treatment on post treatment-initiation alcohol use was mediated by coping skills. The direct path from treatment to follow-up alcohol use was not significant ($\beta = -.09$, $p > .05$; 95% CI = $-.23, .05$); therefore, we found no evidence for a direct effect of treatment. However, the specific indirect effect was statistically significant ($\beta = -.11$, $p < .001$; 95% CI = $-.17, -.04$), suggesting that coping served as a full mediator. In addition, there was a small indirect effect ($\beta = .02$, $p < .05$; 95% CI = $.003, .04$) of psychiatric symptoms on post treatment-initiation alcohol use, mediated through treatment and coping skills. Notably, the significance tests of the indirect effects indicate which mediation effects are nonzero; but, they do not provide information regarding the magnitude

²Based on a reviewer's suggestion, we re-ran the structural model without 3% of participants ($n = 9$) who had a current diagnosis of alcohol abuse, but did not meet criteria for alcohol dependence. Results were virtually identical. Therefore, we decided to retain the full sample for analyses.

of mediation (MacKinnon & Dwyer, 1993). Therefore, we calculated the percentage of the total effect that was mediated. For the total effect of treatment utilization on alcohol use, 45% was a direct effect and 55% was mediated by coping skills. However, readers should interpret these values with caution since the proportion mediated has been shown to be unstable for samples sizes < 500 (Freedman, 2001; MacKinnon, Warsi, & Dwyer, 1995).

Self-Efficacy as a Mediator—Both coping skills ($\beta = -.34, p < .001$; 95% CI = $-.48, -.19$) and self-efficacy ($\beta = -.22, p < .01$; 95% CI = $-.36, -.08$) following treatment initiation were directly related to subsequent alcohol use. Specifically, more frequent coping and higher self-efficacy were associated with less post treatment-initiation alcohol use. However, contrary to our predictions, self-efficacy did not appear to mediate the relation between coping skills and subsequent alcohol use ($\beta = -.03, p > .05$; 95% CI = $-.07, .01$). It should be noted that due to the concurrent assessment of self-efficacy and alcohol use, our analyses provide a limited test of self-efficacy as a mediator.

Discussion

The results of this study showed a close fit between the structural model and the data. Type of pre-treatment residential setting was directly related to treatment, with participants who lived in supervised settings reporting more treatment. Treatment involvement was indirectly associated with outcomes and was mediated by alcohol-specific coping skills. With regard to psychiatric symptoms, participants with fewer initial psychiatric symptoms reported more treatment. In turn, more treatment was related to more frequent use of alcohol-specific coping skills. Importantly, more frequent use of alcohol-specific coping skills was associated with less post treatment-initiation alcohol use.

Our finding of a positive impact of residential treatment setting on alcohol outcomes is consistent with existing research demonstrating the effectiveness of residential programs on substance use outcomes for SMI-SUD individuals (see review by Brunette, Mueser, & Drake, 2004). The finding that more days of treatment predicted better alcohol outcomes is consistent with those of Grella and Stein (2006), who followed 351 SMI-SUD individuals attending a residential drug treatment program. The Grella study showed that longer treatment durations predicted less alcohol use at 6-month follow-up, but potential mediators of this relationship were not tested. Our data do not support a direct relation between extent of treatment involvement and post treatment-initiation alcohol use. Rather, the data provide evidence that alcohol-specific coping skills mediate this relationship, such that more frequent use of alcohol-specific coping skills result in less post treatment-initiation alcohol use. Our results are not consistent with those of Maisto et al. (2000), who examined the prospective relationships among alcohol treatment, coping skills, abstinence self-efficacy, and alcohol outcomes among 142 inpatients and outpatients with an AUD but no SMI. They found evidence of a direct relationship between treatment and alcohol use 12 months following treatment initiation and no evidence of a skills mediation effect. Two possible explanations for this discrepancy are (1) our study recruited SMI individuals while the Maisto study recruited non-SMI individuals, and (2) our considerably larger sample size resulted in greater statistical power to detect relationships.

Consistent with Maisto et al. (2000), we found that abstinence self-efficacy did not appear to mediate the relationship between coping skills and alcohol outcomes. Of course, our test of self-efficacy as a mediator was limited by the concurrent assessment of mediator and outcome. It also is possible that self-efficacy (measured later in our temporal order at month 6) was accrued due to abstinence during follow-up. As a result, self-efficacy was influenced to a greater extent by abstinence than by treatment factors. Therefore, it may be that self-efficacy change is not needed for treatment-related behavior change to occur. Another possibility is that

the high level of stability in coping self-efficacy over the six-month interval may have reduced our ability to detect prospective effects.

In this study, we examined cognitive and behavioral coping behavior but did not analyze data on the specific coping strategies used, making it impossible to draw conclusions regarding the most effective coping strategies for investigation or evaluation in future treatment studies. On the other hand, it may be that engaging in any coping strategy is better than engaging in none at all. This idea is similar to indications from the treatment literature for depression, which shows that individuals who engage in daily activities, such as physical exercise, fare better in terms of depression symptoms compared to those individuals who do not initiate daily activities (Dunn et al., 2005; Harris, Cronkite, & Moos, 2006).

Clinical Implications

The results of our study have four main implications for dual-diagnosis treatment. First, the high percentage of **followed** participants (63%) with good clinical outcomes (based on a composite clinical outcome measure developed for use in Project MATCH) highlights the prospects for good post treatment-initiation alcohol outcomes among dually-diagnosed individuals. Even assuming that participants lost to followup had poor clinical outcomes, over 50% of consenting patients had good clinical outcomes. This proportion is consistent with those found by Donovan and colleagues (2008) at their 6-month follow-up assessment. Based on a sample of 1,383 alcohol dependent individuals seeking outpatient treatment (excluding patients with more severe psychiatric comorbidity), Donovan et al. found that 54.1% were “good clinical responders” at 26-weeks post treatment-initiation. Since the current sample consisted of SMI individuals, the high percentage of good clinical responders is noteworthy and suggests a favorable prognosis for alcohol outcomes among SMI-AUD individuals. Second, our finding that more treatment days result in better alcohol outcomes suggests that dual-diagnosis treatment clinics should provide interventions that increase engagement and retention of **treated individuals with SMI-SUD**. Motivational interventions have shown some promise in engaging SMI-SUD individuals in treatment (Martino, 2007; Martino, Carroll, Nich, & Rounsaville, 2006). Third, fewer psychiatric symptoms were associated with attending more treatment, which in turn, was associated with better alcohol outcomes. This finding highlights the importance of rapid reduction of psychiatric symptoms in order to reduce the risk of treatment dropout. Medications effective for treating the presenting psychiatric symptoms should be administered and their effect on the psychiatric symptoms monitored at frequent intervals to address side effects or lack of effectiveness that may lead individuals to terminate treatment prematurely (Ilgen & Moos, 2006). Lastly, our finding that alcohol-specific coping skills mediate the relationship of number of days of treatment and alcohol outcomes suggests that the focus of treatment should be interventions that improve alcohol-specific coping skills to help SMI-AUD individuals manage high-risk alcohol use situations. This treatment strategy is supported by recent studies demonstrating the feasibility (Shaner et al., 2003) and efficacy (Bellack et al., 2006) of coping skills interventions with SMI-SUD individuals. However, design and methodological problems with both studies highlight the need for further research.

Conclusions

The major strengths of the current study include its use of a theoretical approach to assessing post treatment-initiation functioning among persons with co-occurring SMI-AUD disorders. A large sample size for SEM analyses, as well as prospective data, allowed us to rigorously test coping skills as a mediator. The hypothesized model explained a large amount of variance in coping behavior and post treatment-initiation alcohol use, highlighting the model's utility for SMI-AUD samples.

Further research is needed to examine the types of alcohol-specific coping skills that positively impact alcohol outcomes, the influence of treatment quality and that of psychiatric and addictions pharmacotherapy adherence on alcohol outcomes. Moreover, inclusion of other variables in the model, such as motivational variables (e.g., motivation to change), might enhance the predictive power of the model and allow the independent relationships of coping skills and other mediators to subsequent variables (including outcomes) to be more accurately assessed. The association of supervised residential setting to better alcohol outcomes suggests that more research is needed to determine which features of residential settings may improve outcomes (e.g., program requirements for abstinence or treatment, reduced access to alcohol and drugs, supportive peer group). Future research also might consider related outcomes such as alcohol problems, psychiatric symptoms and drug use.

Study limitations include a reliance on self-report data, which may have resulted in inflated correlations among study variables and a focus on relatively short-term (i.e., 6-month) as opposed to longer term (e.g., > 1 year) outcomes that may enhance our understanding of the long-term course of recovery (Drake, O'Neal, & Wallach, 2008). Despite these limitations, the results of this study make a substantial contribution to the literature. The multivariate, longitudinal model employed in the present study accounts for the influence of multiple factors on alcohol use outcomes. Notably, it emphasizes the importance of psychosocial interventions with SMI individuals, in particular, those that improve alcohol-specific coping skills as means of enhancing post treatment-initiation alcohol outcomes.

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□ □

Figure 1.
Conceptual model for studying alcohol outcomes among individuals with SMI.

Figure 2.
Participant flow CONSORT diagram.

Figure 3.

Hypothesized conceptual model. Squares or rectangles indicate measured variables and circles indicate latent variables (measured variable indicators are not shown). Plus signs refer to expected positive relationships and minus signs refer to expected negative relationships.

Figure 4.

Results of structural model. $N = 278$. Gender: 0 = male, 1 = female; Type of residential setting: 0 = unsupervised, 1 = supervised. Standardized estimates are shown. All exogenous variables were allowed to correlate freely in the model. Correlations among exogenous model variables are not shown.

$^{\dagger}p < .10$. $^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 1
Means and Standard Deviations for Psychosocial, Treatment Utilization, and Alcohol Use Measured Variables

Variable	Assessment					Cohen's <i>d</i>
	Baseline <i>M</i> (<i>SD</i>)	Months 1-4 <i>M</i> (<i>SD</i>)	Month 4 <i>M</i> (<i>SD</i>)	Months 5 + 6 <i>M</i> (<i>SD</i>)	Month 6 <i>M</i> (<i>SD</i>)	
<i>Psychiatric Symptoms</i>						
BSI: Paranoid ideation ^a	1.86 (.99)					
BSI: Negative affectivity (depression/anxiety) ^a	1.78 (.96)					
SCI-PANSS: Positive symptoms ^b	12.57 (3.62)					
<i>Coping Skills and Self-Efficacy</i>						
CBI: Positive thinking ^c	1.82 (.67)		2.02 (.66)			.30
CBI: Negative thinking ^c	1.88 (.67)		1.98 (.70)			.15
CBI: Avoidance ^c	1.47 (.56)		1.52 (.57)			.08
CBI: Social support ^c	1.42 (.70)		1.61 (.73)			.27
AACQ: Self-efficacy ^d	171.83 (50.25)				186.76 (51.63)	.29
<i>Treatment Utilization</i>						
No. of days of any treatment (formal outpatient or self-help)		57.40 (34.49)				
<i>Alcohol Use^e</i>						
Drinks per drinking day	6.81 (9.27)			2.92 (5.02)		.52
No. of heavy drinking days	8.95 (13.31)			4.07 (10.85)		.40
No. of drinking days	12.61 (16.45)			6.69 (13.84)		.39

Note. AACQ = Alcohol Abstinence Self-Efficacy. BSI = Brief Symptom Inventory. SCI-PANSS = Structured Clinical Interview for the Positive and Negative Syndrome Scale. CBI = Coping Behaviors Inventory. DDD = Drinks per drinking day. Untransformed means and standard deviations are reported. *N* = 278 at baseline for all scale scores, except SCI-PANSS (*n* = 261) and AACQ (*n* = 187). For treatment utilization (months 1-4), *n* = 263. For Month 4 scale scores, *n* = 198. For Months 5+6 alcohol use variables, *n* = 235-236. For Month 6 AACQ, Self-efficacy, *n* = 181.

^aResponses to the BSI were made on a 5-point scale (0 = *Not at all*, 4 = *Extremely*) regarding symptoms in the past week and then averaged for scoring.

^bResponses to the SCI-PANSS were made on a 7-point scale (1 = *Absent*, 7 = *Extreme*) and then summed for scoring.

^cResponses to the CBI were made on a 4-point scale (0 = *Never*, 3 = *Usually*) regarding how frequently each strategy was used in the past 12 months (baseline) or past 2 months (follow-up). Responses were averaged for scoring.

^dResponses to the AACQ were made on a 5-point scale (1 = *Definitely would drink*, 5 = *Definitely would not drink*). The AACQ total score was computed by summing all 50 items.

^eFewer participants at baseline (31%) than at follow-up months 5 & 6 (54%) reported continuous abstinence from alcohol during the previous 60 days, $\chi^2(1) = 21.51, p < .001$.

Table 2

Factor Loadings from Test of Measurement Model

Latent factor and indicator	Factor loading		
	Baseline	Follow-up Month 4	Follow-up Months 5 & 6
<i>Psychiatric symptoms</i>			
Paranoid ideation (BSI) ^a	.95	--	--
Negative affectivity (BSI)	.77***	--	--
Positive symptoms of schizophrenia (PANSS-positive)	.41***	--	--
<i>Coping skills</i>			
Positive Thinking (CBI) ^a	.91	.92	--
Negative Thinking (CBI)	.75***	.83***	--
Avoidance (CBI)	.77***	.62***	--
Seeking Social Support (CBI)	.77***	.78***	--
<i>Alcohol use</i>			
No. of drinking days (TLFB) ^a	.78	--	.80
No. of heavy drinking days (TLFB)	.98***	--	.96***
Drinks per drinking day (TLFB)	.79***	--	.77***

Note. Standardized coefficients (based on STDYX standardization in Mplus) are reported. All significance tests are based on univariate *z*-tests of unstandardized coefficients.

^aStatistical significance of the loading was not tested because loading was fixed at 1.0 to set the scale of the latent factor.

p < .001.