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Profiles of Recovery from Alcohol Use Disorder at Three Years Following Treatment: Can the Definition of Recovery be Extended to Include High Functioning Heavy Drinkers?

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Abstract

Background and Aims: Recovery from alcohol use disorder (AUD) is often narrowly defined by abstinence from alcohol and improvements in functioning (e.g., mental health, social functioning, employment). This study used latent profile analysis to examine variability in recovery outcomes, defined by alcohol use, alcohol-related problems, and psychosocial functioning at three years following treatment. Secondary analysis investigated pre-treatment, post-treatment, and one- and three-year post-treatment covariate predictors of the latent profiles.

Design: Secondary analysis of data from a randomized clinical trial.

Setting: USA

Participants: We used data from the outpatient arm of Project MATCH (n=805; 29.7% female, 22.2% non-White).

Measurements: Recovery was defined by latent profile analyses including measures of psychosocial functioning and life satisfaction (Psychosocial Functioning Inventory), unemployment and mental health (Addiction Severity Index), alcohol and other drug use (Form 90), and alcohol-related consequences (Drinker Inventory of Consequences) three years following treatment. Mixture modeling was used to examine correlates of profiles.

Findings: We identified four profiles at three years following treatment: 1) poor functioning frequent heavy drinkers, 2) poor functioning infrequent heavy drinkers, 3) high functioning occasional heavy drinkers, and 4) high functioning infrequent non-heavy drinkers. There were relatively few differences on indicators of functioning and treatment-related variables between the high functioning infrequent non-heavy drinkers and the high functioning occasional heavy drinkers, other than high functioning occasional heavy drinkers having lower alcohol dependence severity (OR=0.94, 95% CI: 0.90, 0.98), fewer post-treatment coping skills (OR=0.54, 95% CI: 0.27, 0.81), and lower three-year post-treatment abstinence self-efficacy (OR=0.37, 95% CI: 0.27, 0.47), and AA involvement (OR=0.87, 95% CI: 0.74, 0.99). The two high functioning profiles showed the greatest improvements in functioning from baseline through the 3-year follow-up, whereas the low functioning profiles showed the least amount of improvement. High functioning occasional heavy drinkers had higher purpose in life than the poor functioning profiles.

Conclusions: Some individuals who engage in heavy drinking following treatment for alcohol use disorder may function as well as those who are mostly abstinent with respect to psychosocial functioning, employment, life satisfaction, and mental health.

Keywords

alcohol use disorder; alcohol treatment; recovery; mixture models; Project MATCH

Introduction

The term “recovery,” with respect to alcohol use disorder (AUD) is often defined as a period of sustained abstinence from alcohol [1,2]. Broader definitions of recovery often incorporate physical and mental health, social, recreational, and leisure activities, and work, family, or community engagement [3–9]. In two qualitative studies of individuals who self-identified as “in recovery” [4] and treatment providers [9], participants indicated abstinence, physical and mental health, housing, social functioning, and well-being as important in defining recovery. Thus, recovery community members and practitioners embrace broader definitions of recovery that consider a range of psychological, physical, and social functioning outcomes, with abstinence included in the definition.

Many predictors of recovery outcomes have been studied. Individuals who are married, female, and older [10], with fewer heavy drinkers in their social network [11], greater coping skills [12], fewer psychiatric disorders [10], lower levels of depression and anger [13,14], higher levels of purpose in life and Alcoholics Anonymous (AA) attendance [15,16], and a higher level of abstinence self-efficacy [17,18] tend to have better outcomes following treatment. Higher alcohol dependence severity is associated with an increased odds of an abstinent recovery (defined as abstinence from alcohol and remission from alcohol

dependence symptoms), but decreased odds of a non-abstinent recovery (defined as low risk drinking and remission from alcohol dependence symptoms) [19].

Current Study

Researchers, policy makers, and government agencies have advocated for a broader definition of AUD recovery to incorporate functioning outcomes and for a better understanding of the critical elements that support recovery. Yet, prior studies have relied on a limited definition of alcohol use (abstinence) in considering broader definitions of recovery [4,19–21], and no prior studies have considered a range of outcomes in which both alcohol use and functioning define recovery. Accordingly, the primary purpose of this study was to use latent profile analysis to examine variability in recovery outcomes, defined by alcohol use, alcohol-related problems, and psychosocial functioning at three years following treatment. Based on prior studies that have found low risk drinkers to be similar to abstainers on outcomes [23–25], we hypothesized that at least two profiles would be identified: abstinent or low risk drinking with high functioning (i.e., recovery), and heavy drinking with low functioning (i.e., not recovered). A second aim of this study was to investigate pre-treatment, post-treatment, and one- and three-year post-treatment covariate predictors of the latent profiles.

Method

Participants and Procedure

The current study was a secondary analysis of data from the outpatient arm of Project MATCH [22], a randomized clinical trial of three psychosocial treatments for AUD: Cognitive Behavioral Therapy (CBT) [23], Motivational Enhancement Therapy (MET) [24], and Twelve-Step Facilitation (TSF) [25]. Participants ($n=952$) were recruited from nine research centers in the United States and included individuals who were seeking outpatient treatment. Of the 952 recruited patients, 806 patients (84.7%) had drinking data available during the three-year follow-up period and were included in the present analyses. All participants met DSM-III-R criteria for alcohol abuse ($n=74$, 9.2%) or dependence ($n=732$, 90.8%). Measures were assessed at baseline, during 12 weeks of treatment, immediately post-treatment (3-months post-baseline), six months post-treatment (9-months post-baseline), 12 months post-treatment (15-months post-baseline), and three years following treatment (39-months post-baseline).

Measures

Three-Year Follow-Up Latent Profile Indicators

Alcohol and other drug use.: Alcohol and drug use were measured using the Form-90 [26], a calendar-based method to obtain reports of alcohol/drug use in the previous 90-day period. Summary alcohol use variables included percent drinking days (PDD), percent heavy drinking days (PHDD, i.e., 4 or more drinks in a day for women, 5 or more drinks in a day for men), and drinks per drinking day (DDD). Marijuana and other illicit drug use were coded as binary (0=no use, 1=any use).

Alcohol-related negative consequences.: The Drinker Inventory of Consequences (DrInC) [27] was used to measure alcohol-related negative consequences. Clients reported the frequency of 45 alcohol-related consequences (e.g., “I have gotten into trouble because of drinking”) on a 4-point scale (1=never, 4=daily or almost daily). Internal consistency of DrInC in this sample was $\alpha=0.97$.

Psychosocial functioning and employment.: The Psychosocial Functioning Inventory (PFI)[28] was used to measure social functioning. The social behavior subscale was calculated from 10 items of the PFI and included items that assess the frequency of problematic social behavior and social interactions in the past 30 days (e.g., “Demanded others do things your way”). Higher scores on the social behavior subscale indicate better psychosocial functioning. Internal consistency of the PFI social behavior subscale was $\alpha=0.83$. We also selected four items to reflect satisfaction with life and social functioning over the past 30 days: “How happy have you been... with life?”; “...with your living situation?” and “...with your relationships?”; and “Did you feel satisfied with leisure, social, and recreational activities?” (0=satisfied/happy; 1=dissatisfied/unhappy). The internal consistency of these four items was $\alpha=0.79$.

The Addiction Severity Index (ASI)[29] was used to measure employment and experiences of “serious depression,” cognitive difficulty (“trouble understanding, concentrating, or remembering”), and “serious anxiety or tension” in the past 30 days. All items were binary indicators where 0=employed or symptom not present, and 1=unemployed or symptom present. Given prior evidence of poor measurement properties of the ASI composites, we followed a recommendation to examine individual items [30]. The internal consistency of the four ASI items was $\alpha=0.63$.

Covariates—Covariate predictors of profile membership were included based on prior studies examining predictors of AUD treatment outcomes [10,17,31–34] and availability of measures in the Project MATCH dataset. Three time periods were represented: pre-treatment (i.e., baseline), end of treatment (three months following baseline), and follow-up (one and three years post-treatment).

Pre-treatment predictors of recovery outcomes included (1) demographic variables (age, sex, race, marital status), (2) treatment condition, (3) baseline alcohol dependence severity assessed by the Alcohol Dependence Scale [35], and (4) social network support for drinking assessed by the Important People and Activities Instrument [36].

End of treatment predictors of recovery outcomes included (1) coping as measured by the Process of Change Questionnaire [37,38], and (2) achieving a mostly low risk pattern of drinking or abstinence during treatment, as derived in prior analyses of during treatment drinking [32].

One year post-treatment predictors included (1) depression scores assessed by the Beck Depression Inventory [39], (2) anger scores assessed by the Spielberger State-Trait Anger Expression Scale [40], (3) purpose in life assessed by the Purpose in Life test [41], and (4) psychiatric severity assessed by the Addiction Severity Index [29].

Three-year post-treatment predictors included (1) self-efficacy as assessed by the Alcohol Abstinence Self-Efficacy Scale, Confidence subscale [42]; (2) social support from family and friends assessed by the Social Support Questionnaire short form [43,44]; (3) Alcoholics Anonymous involvement [45]; and (4) cigarettes smoked per day assessed by the Form 90 [26].

Analytic Approach

Descriptive Analyses—Descriptive analyses were conducted using levels of drinking during the three-year follow-up assessment as a grouping variable with three observed groups: abstainers, low risk drinkers (i.e., non-abstinent individuals with no heavy drinking days), and heavy drinkers.

Latent Profiles of Three Year Outcomes—Latent profile analyses were conducted in *Mplus* version 8 [46] using a weighted maximum likelihood function, which provides the estimated variance-covariance matrix for all available data, thus all data were included in the models ($n=806$). Model fit of the latent profile models without covariates was examined using the Lo Mendell Rubin Likelihood Ratio test (LRT), Bayesian Information Criterion (BIC) and sample-size-adjusted BIC (aBIC). Lower BIC and aBIC indicate better fitting models and a significant LRT indicates a significantly better fit for a k profile model (e.g., four profiles) versus a $k-1$ profile model (e.g., three profiles) [47]. A non-significant LRT indicates that adding an additional profile does not significantly improve model fit [47]. Classification precision (relative entropy) was used to evaluate how well the latent profile solution classified individuals into latent profiles (entropy >0.80 was considered good classification precision). Models were tested initially using a split-half validation and replication approach. Final models were tested with the full sample.

Change in Functioning from Baseline by Latent Profiles—Once latent profiles at three years following treatment were identified, we examined average functioning (means and 95% confidence intervals) from baseline (month 0), end of treatment (month 3), and following treatment (months 9 and 15) by latent profile membership. Only outcomes assessed at baseline and 3-, 9-, and 15-months in the Project MATCH data were examined, including alcohol consumption, drinking consequences, marijuana use, other illicit drug use, PFI social behavior, PFI satisfaction with leisure, social, and recreational activities, and depression, tension, and difficulty concentrating.

Correlates of Latent Profiles—Finally, we examined the association between covariates and profiles using a model-based multinomial logistic regression. For all models we examined associations with covariates that were assessed closest in time to the three-year follow-up assessment. Given different levels of missingness for each of the covariates (complete case analysis $n=491$), we used multiple imputation with 20 imputed datasets for the covariate models, thus the full sample ($n=806$) was used for the covariate analyses.

Results

Descriptive Analyses

Among the outpatient sample included in the present study ($n=806$; 84.6% of the MATCH outpatient sample), 29.7% were female, 22.2% were non-White (77.8% non-Hispanic White, 13.5% Hispanic, 5.7% Black, 2.0% American Indian or Alaska Native, 0.7% “other,” and 0.2% Asian or Pacific Islander), and the mean age was 38.1 ($SD=10.5$). Reasons for not completing the 3-year follow-up assessment included being lost to follow-up (4.7%), refused participation (7.7%), and being deceased (2.9%).

The means (standard deviations) for continuous outcomes and number endorsing (%) for binary outcomes at three years following treatment are provided in Table 1. We also examined the means and endorsement by observed abstinence ($n=237$; 29.4%), low risk drinking ($n=91$; 11.3%), and heavy drinking ($n=478$; 59.3%) status at three-years post-treatment. Abstainers and low risk drinkers were not significantly different from one another on nearly all non-drinking outcomes ($ps>0.05$), with only one exception: abstainers were significantly more unhappy with life compared to low risk drinkers ($\chi^2(1)=4.31$; $p=0.04$).

Latent Profiles of Three Year Outcomes

Latent profile models with two through nine profiles were estimated and a four-profile model was retained as the optimal solution in validation and replication sub-samples. The data were then combined and re-estimated with the total sample. Consistent with the validation and replication sub-samples, in the combined sample the three profile model was rejected in favor of a four profile model ($LRT=554.61$, $p=0.03$) and the five profile model did not fit significantly better than the four profile model ($LRT=463.97$, $p=0.15$). The BIC and aBIC continued to decrease with each additional profile. The classification precision of the four-profile model was excellent (entropy=0.92). The profiles were also substantively meaningful. See Figure 1 for standardized scores (mean=0, $SD=1$) on the continuous outcomes and Figure 2 for probability of endorsing binary outcomes by profile.

Profile 1 (15.8% of the total sample), “low functioning frequent heavy drinking,” reported $PDD=84.5\%$, $PHDD=79.2\%$, $DDD=11.2$, and $DrInC=56.1$, below average PFI social behavior (see Figure 1), and a higher likelihood of endorsing unemployment, other drug use, psychiatric symptoms, and life dissatisfaction (see Figure 2). Profile 2 (16.1% of the total sample), “low functioning infrequent heavy drinking,” reported $PDD=16.4\%$, $PHDD=9.7\%$, $DDD=4.8$, and $DrInC=43.7$, below average PFI social behavior, and the highest likelihood of endorsing unemployment, psychiatric symptoms, and life dissatisfaction. Approximately 20% of those in Profile 2 endorsed other drug use. Profile 3 (16.9% of the total sample), “high functioning occasional heavy drinking,” reported $PDD=67.9\%$, $PHDD=25.5\%$, $DDD=5.9$, and $DrInC=32.5$, above average PFI social behavior, and a low probability of endorsing unemployment, other drug use, psychiatric symptoms, and life dissatisfaction. Profile 4 (51.2% of the sample), “high functioning infrequent non-heavy drinking,” reported $PDD=6.9\%$, $PHDD=2.8\%$, $DDD=2.1$, and $DrInC=15.7$, above average PFI social behavior, and a low probability endorsing unemployment, other drug use, psychiatric symptoms, and life dissatisfaction.

The high functioning infrequent non-heavy drinking profile (Profile 4) and the low functioning infrequent heavy drinking profile (Profile 2) both included a large number of abstainers. Among individuals most likely classified in Profile 4, 48.9% were abstinent from alcohol and 44.8% were abstinent from alcohol and other drugs. Among individuals most likely classified in Profile 2, 26.9% were abstinent from alcohol and 19.2% were abstinent from alcohol and drugs. No individuals in Profile 1 and Profile 3 were abstinent from alcohol.

Change in Functioning from Baseline by Latent Profiles

To determine whether the profiles at three years following treatment were indicative of change from baseline on outcomes we examined average functioning (means and 95% confidence intervals) from baseline (month 0) through the three year (month 39) follow-up by latent profile membership. As seen in Figure 3, individuals in Profiles 3 and 4 had lower drinking intensity over time than individuals in Profile 1, and individuals in Profile 2 and 4 reported less drinking frequency over time than individuals in Profiles 1 and 3. Figures 4 and 5 show that individuals in the high functioning profiles (Profiles 3 and 4) showed the greatest recovery of functioning through the three-year follow-up. Individuals in the low functioning profiles (Profiles 1 and 2) had less initial improvement and deterioration of functioning over time.

Correlates of Latent Profiles

Next, we examined the associations between patient characteristics and latent profiles using model-based multinomial logistic regression. In these models, all covariates were included as predictors of latent profile membership with one profile as the reference profile. For descriptive purposes, the means (standard deviations) for continuous covariates and frequency of endorsing binary covariates at three years following treatment by the four latent profiles (using the highest probability of profile membership) are provided in Table 2. Multinomial logistic regression parameters for patient characteristics predicting odds of membership in each of the latent profiles (rows; odds ratios and 95% confidence intervals (CI) versus the reference profile (columns)) are provided in Table 3.

Of the demographic measures and treatment conditions, only age and race were significantly associated with profile membership. Individuals who were non-Hispanic white had a 2.41 (95% CI 1.09, 5.31) greater odds of membership in Profile 3 (“high functioning occasional heavy drinking”), as compared to Profile 4 (“high functioning infrequent non-heavy drinking”). Younger age predicted a significantly greater probability of membership in Profile 4, as compared to Profile 1 (“low functioning frequent heavy drinking”).

Greater abstinence self-efficacy was associated with a significantly higher probability of being in all other profiles versus Profile 1 (“low functioning frequent heavy drinking” Table 3, column 2). More AA involvement and smoking fewer cigarettes per day were associated with a significantly higher probability of being in the infrequent drinking profiles (Profile 2 and 4) versus Profile 1. Lower anger at 1-year follow-up predicted a significantly higher probability of being in the high functioning profiles (Profiles 3 and 4) versus Profile 1. Similarly, greater purpose in life at 1-year follow-up predicted a significantly higher

probability of being in Profile 3 “high functioning occasional heavy drinking,” as compared to Profile 1. Lower depression, less social support, and achieving low risk drinking or abstinence during treatment predicted a significantly greater probability of membership in Profile 4 “high functioning infrequent non-heavy drinking,” as compared to Profile 1.

Lower psychiatric severity at 1-year follow-up predicted a significantly higher probability of being in all other profiles versus Profile 2 (“low functioning infrequent heavy drinking”; Table 3, column 3). Not achieving abstinence or low risk drinking during treatment and lower coping scores at the end of treatment predicted a higher probability of being in the low functioning heavy drinking profile (Profile 1), as compared to Profile 2. Lower anger at 1-year follow-up predicted a significantly higher probability of being in the high functioning profiles (Profiles 3 and 4) versus Profile 2. Greater purpose in life at 1-year follow-up predicted a significantly higher probability of being in Profile 3 “high functioning occasional heavy drinking,” as compared to Profile 2. Greater social support from family and friends at 3-year follow-up predicted a higher probability of membership in Profile 4 “high functioning infrequent non-heavy drinking,” as compared to Profile 2.

Table 3, columns 4 and 5, provide covariate effects with the “high functioning occasional heavy drinking” profile (Profile 3) and “high functioning infrequent non-heavy drinking” profile (Profile 4) as reference profiles, respectively. Greater alcohol dependence severity and lower social support for drinking at baseline, achieving abstinence or low risk drinking during treatment, and greater abstinence self-efficacy and AA involvement at 3-year follow-up predicted a higher probability of membership in Profile 4, as compared to Profile 3.

Discussion

When examining recovery from AUD as a multidimensional construct reflective of functioning and a range of alcohol consumption indicators, we found support for four distinct profiles. Individuals could be differentiated based on functioning and levels of drinking. Just over half of the sample fit into a profile of infrequent non-heavy drinking with high functioning (51.2%), and the remainder of the sample was split between profiles that included: frequent heavy drinking/low functioning (15.8%), infrequent heavy drinking/low functioning (16.1%), and occasional heavy drinking/high functioning (16.9%). Approximately 49% of the high functioning infrequent heavy drinking profile and 27% of the low functioning infrequent heavy drinking profile reported abstinence. The high functioning profiles were characterized by greater social functioning, less unemployment, lower probability of endorsing depression and anxiety symptoms, less cognitive difficulty, and greater satisfaction with life, relationships, living situation, and social/leisure activities than the low functioning profiles.

Our results suggest that knowing an individual is engaging in some heavy drinking or knowing that an individual is abstinent provides incomplete information about patient functioning. Consistent with our prior work [48] we found success in those who failed to achieve the no heavy drinking definition (e.g., exceeding 4/5 drinks per day for women/men), given that approximately one-third of those in the current study who engaged in some heavy drinking (Profile 3) were functioning well and the other two-thirds (Profiles 1 and 2)

were functioning poorly. Similarly, achieving infrequent drinking or abstinence also did not guarantee higher functioning. Approximately 75% of those who achieved infrequent drinking were high functioning (Profile 4), whereas 25% of those who achieved infrequent drinking had very poor functioning (Profile 2). Approximately 20% of those in Profile 2 engaged in other drug use, which could have also impacted functioning.

Beyond portraying a broader representation of AUD recovery, this work also helped clarify factors that may contribute to both consumption and functional outcomes. At baseline, greater social support for drinking differentiated heavier drinking from less frequent drinking, and lower alcohol dependence severity at baseline predicted high functioning heavy drinking. Better mental health, including fewer psychiatric symptoms, less depression and anger, greater purpose in life, and social support from family and friends were associated with higher functioning at three years following treatment.

Limitations and Future Directions

The current study was limited by the available data in the outpatient sample of Project MATCH. As such, the covariates were assessed at varying time periods. Project MATCH provided a relatively comprehensive assessment of psychological and social functioning, but measures of physical health were not available. Future research that incorporates measures of physical health functioning would provide more information about recovery of functioning [49]. Similarly, reliance on self-report prevented us from ascertaining the perspectives of family, friends, employers, and providers with respect to functioning status (e.g., individuals who were engaging in heavy drinking may not be regarded as “high functioning” among family members).

Using latent profile analysis to identify the profiles is both a limitation and a strength. The identified profiles are probabilistic, and there is always some misclassification of individuals in latent profile analysis. However, using a probabilistic approach also eliminated the need to create cutoffs (e.g., no heavy drinking days; [50,51]) and the validation-replication approach provides greater confidence in the profile solution. Finally, recovery is perhaps better conceptualized as a process of change [52], whereas the current study examined outcomes at a single point in time. Replication in a new sample and consideration of additional covariates, especially cognitive functioning/executive control, medical health and chronic pain, and misuse of prescription drugs are important future directions for this work.

Consensus statements have suggested broad definitions of recovery [1,4,9,52]. The present study supports and extends these previous studies by calling into question how recovery from AUD is conceptualized. Acknowledgment of client heterogeneity was an essential element that guided the primary aims of Project MATCH [22]. Specifically, because of client heterogeneity, the research team hypothesized that certain clients would respond more favorably to certain treatments. It may also be time for the field to acknowledge the heterogeneity in how individuals recover from an AUD. Using any single indicator as a benchmark to define success in recovery, such as abstinence, makes an implicit assumption that recovery is an easily defined construct and that alcohol use is directly and uniquely connected with psychosocial functioning. AUD is a complex syndrome with diverse presentation; we should expect recovery from AUD to be similarly complex. The importance

of taking a broad perspective in defining AUD outcomes based on multiple areas of life functioning, has been advocated for decades [52]. The results from the current study provide empirical support for a broader definition of recovery based on functioning and a range of alcohol use, including some heavy drinking.

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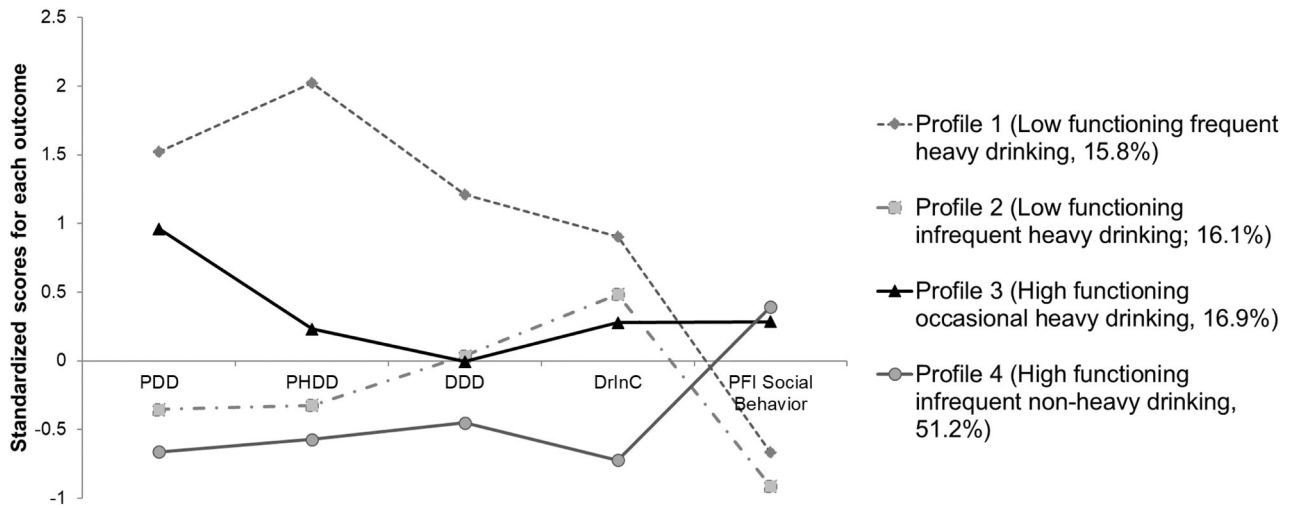


Figure 1. Standardized Mean Scores (Sample Mean = 0 and Standard Deviation = 1) on each of the Continuous Outcome Indicators by Latent Profiles

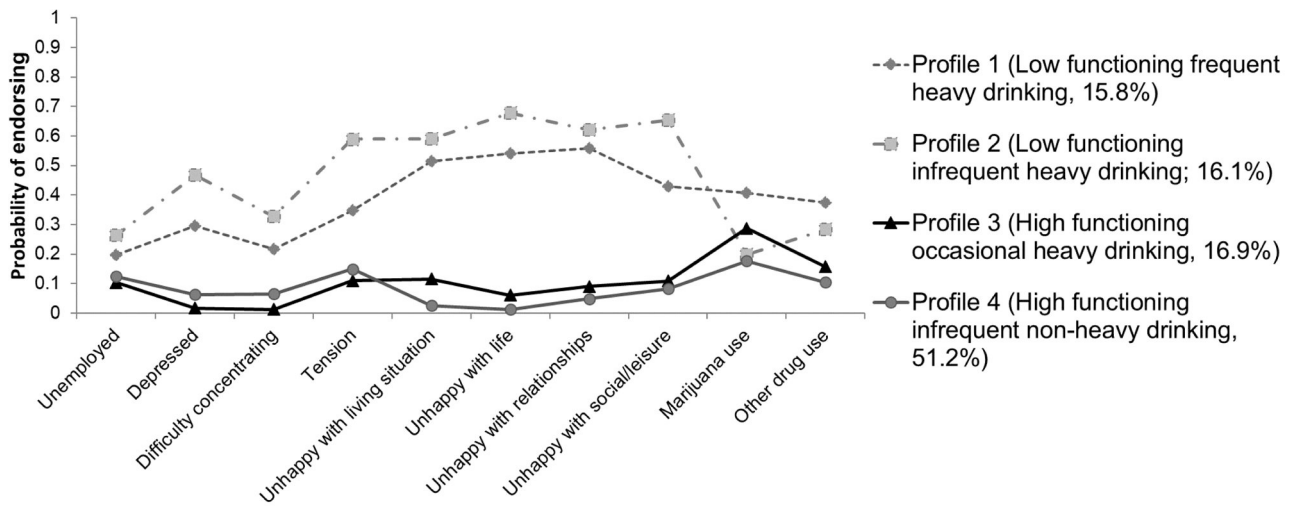


Figure 2.
Probability of Endorsing each of the Binary Outcome Indicators by Latent Profiles.

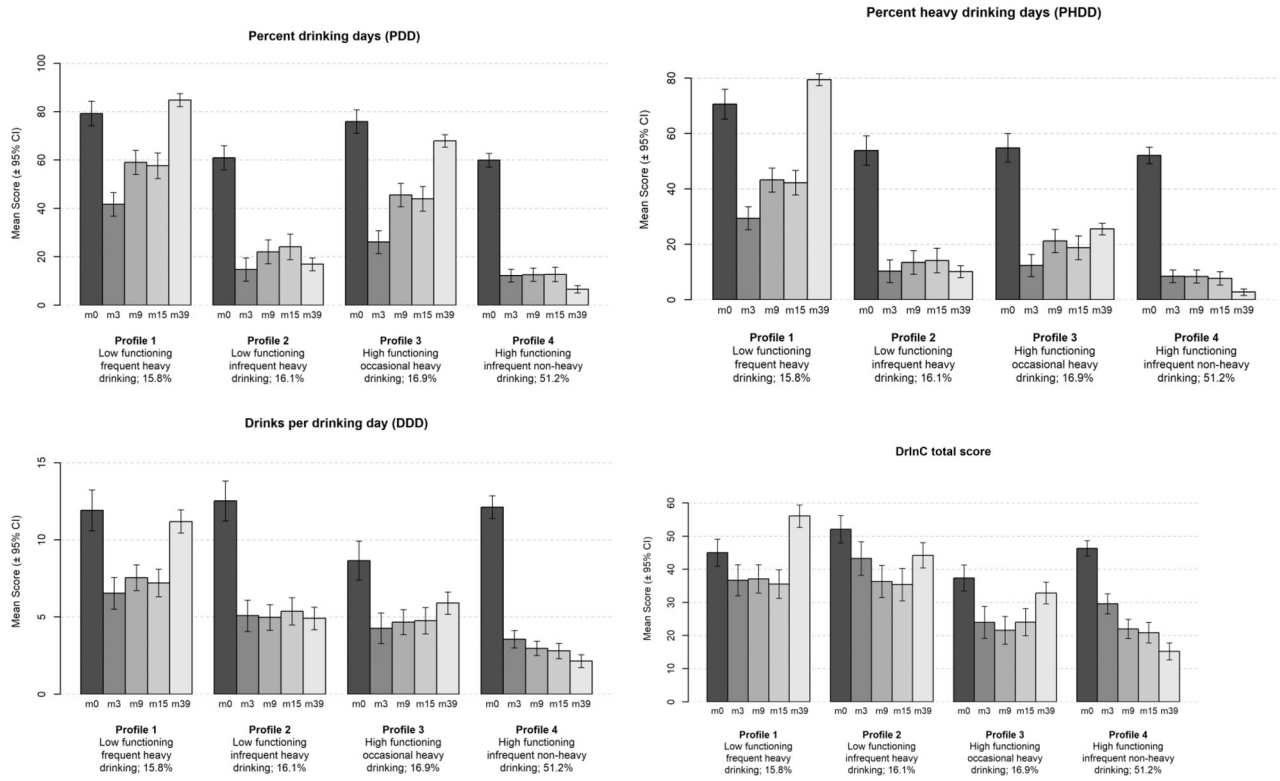


Figure 3. Change in Consumption Outcomes and Drinking Consequences over Time at Baseline (m0), End of Treatment (m3), and 9- (m9), 15- (m15), and 39- (m39) months following Treatment by Latent Profiles

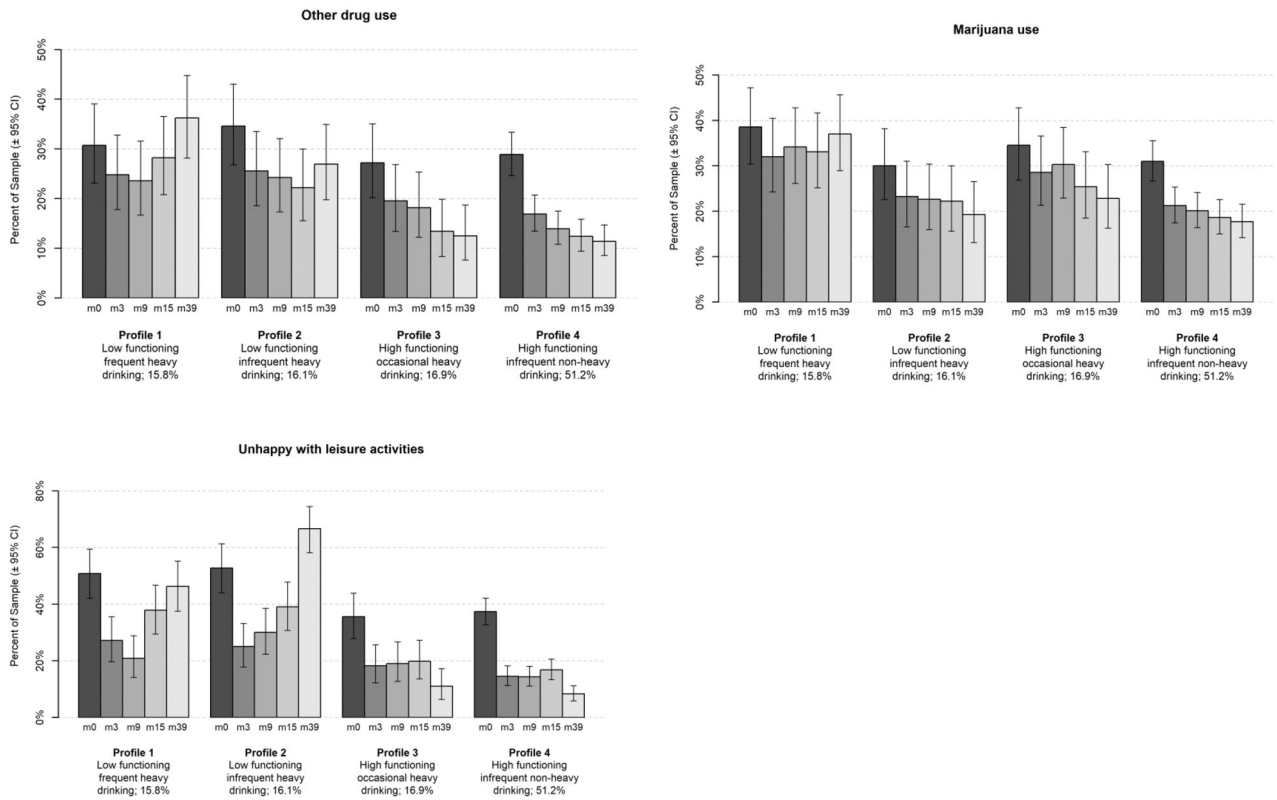


Figure 4. Change in Drug Use Outcomes and Satisfaction with Leisure Activities over Time at Baseline (m0), End of Treatment (m3), and 9- (m9), 15- (m15), and 39- (m39) months following Treatment by Latent Profiles

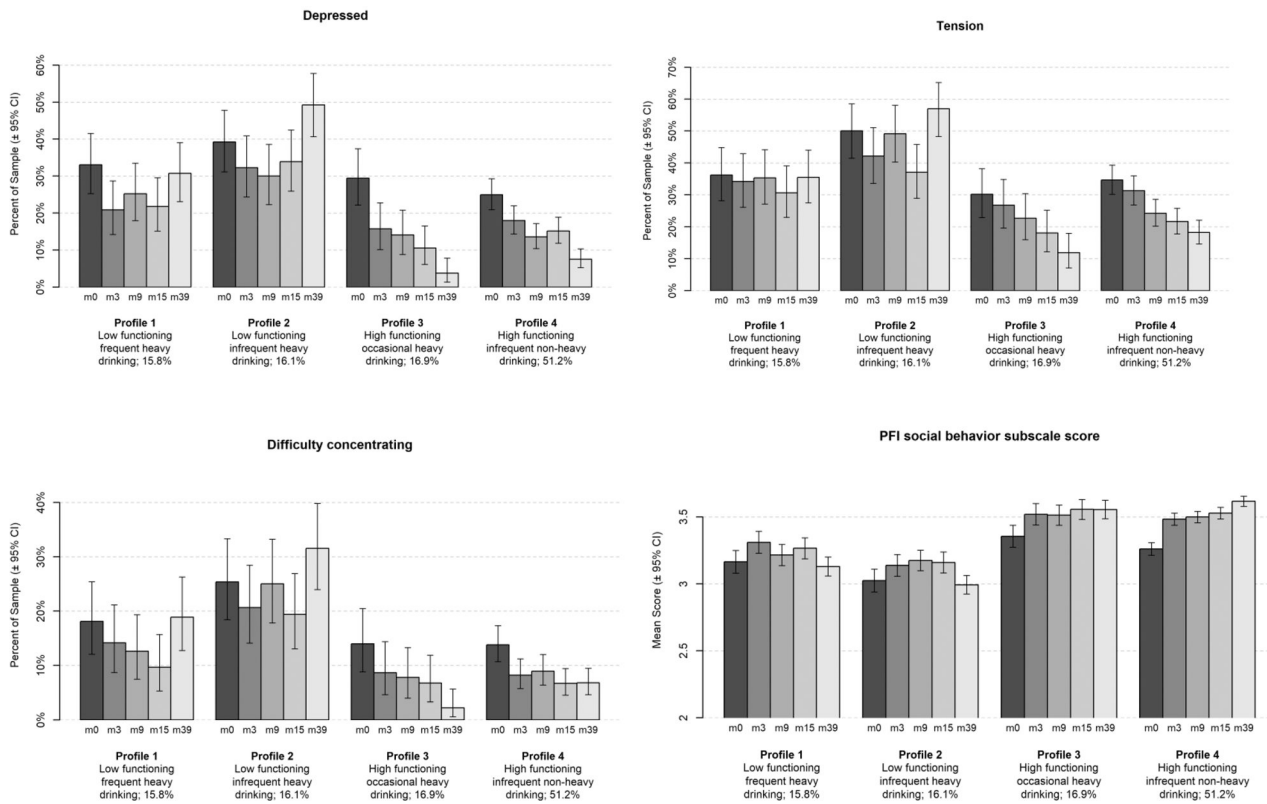


Figure 5. Change in Mental Health Symptoms (ASI) and Social Functioning (PFI) over Time at Baseline (m0), End of Treatment (m3), and 9- (m9), 15- (m15), and 39- (m39) months following Treatment by Latent Profiles

Table 1.

Means (SD) and Number Endorsing (%) Outcomes Three Years Post-Treatment in the Total Sample and by Observed Drinking Categories Three Years Post-Treatment

Continuous Indicators	Total Sample N=806 M (SD)	Abstainers n=237 M (SD)	Low risk drinkers n=91 M (SD)	Heavy drinkers n=478 M (SD)
Percent drinking days (PDD)	30.9% (35.6%)	0.0% (0.0%)	26.3% (32.5%)	47.1% (34.5%)
Percent heavy drinking days (PHDD)	19.9% (29.8%)	0.0% (0.0%)	0.0% (0.0%)	33.5% (32.2%)
Drinks per drinking day (DDD)	4.64 (5.33)	0.00 (0.00)	1.78 (1.16)	7.49 (5.23)
DrInC total score	33.25 (24.89)	6.20 (8.99)	13.77 (14.09)	37.20 (24.64)
PFI social behavior subscale score	3.43 (0.47)	3.51 (0.41)	3.54 (0.41)	3.37 (0.50)
Binary Indicators	Total Sample N (%)	Abstainers N (%)	Low risk drinkers N (%)	Heavy drinkers N (%)
Unemployment	118 (14.8)	37 (15.7%)	11 (12.4%)	70 (14.7%)
Depressed	139 (17.3%)	32 (13.5%)	12 (13.2%)	95 (19.9%)
Difficulty concentrating	96 (11.9%)	28 (11.8%)	6 (6.8%)	62 (13.0%)
Tension	210 (26.1%)	54 (22.8%)	25 (27.5%)	131 (27.5%)
Unhappy with living situation	165 (21.5%)	37 (16.2%)	12 (14.5%)	116 (25.4%)
Unhappy with life	166 (21.8%)	24 (15.0%)	5 (6.1%)	127 (28.0%)
Unhappy with relationships	172 (22.5%)	37 (16.2%)	11 (12.4%)	124 (27.3%)
Unhappy with leisure activities	187 (24.2%)	36 (15.6%)	17 (20.5%)	134 (29.1%)
Marijuana use	176 (21.8%)	22 (9.3%)	15 (16.5%)	134 (29.1%)
Other drug use	145 (18.0%)	27 (11.4%)	8 (8.8%)	110 (23.0%)

Note. DrInC=Drinker Inventory of Consequences; PFI=Psychosocial Functioning Inventory.

Table 2. Frequencies and Means (Standard Deviation) for Demographic and Risk Covariates by Latent Profiles

Baseline Covariates (sample size out of n=806 in 3 year follow-up sample)	Profile 1:	Profile 2:	Profile 3:	Profile 4:
	Low Functioning Frequent Heavy Drinking	Low Functioning Infrequent Heavy Drinking	High Functioning Occasional Heavy Drinking	High Functioning Infrequent Non-Heavy Drinking
Sex % Male (n=806)	76%	69%	74%	71%
Marital status % Married (n=804)	41%	43%	46%	43%
Race % White (n=806)	84%	80%	85%	76%
Age (n=806)	38.80 (9.67)	37.97 (10.12)	40.63 (11.25)	37.99 (10.95)
Social support for drinking (IPA, n=787)	6.30 (1.05)	6.29 (0.99)	6.40 (1.05)	6.12 (1.10)
Alcohol dependence (ADS, n=799)	15.23 (6.84)	16.35 (6.88)	12.28 (6.21)	15.03 (7.53)
End of Treatment Covariates				
Low risk drinking or abstinence (n=771)	29%	47%	41%	60%
Coping (PCQ, n=776)	2.94 (0.61)	3.25 (0.51)	2.86 (0.67)	3.17 (0.64)
One Year Post-Treatment Covariates				
Psychiatric severity (ASI, n=771)	0.13 (0.19)	0.19 (0.20)	0.07 (0.13)	0.09 (0.15)
Depression (BDI, n=746)	10.40 (7.78)	10.83 (8.32)	5.78 (5.58)	5.11 (6.90)
Anger (STAX, n=754)	27.89 (6.90)	29.18 (6.98)	24.47 (5.59)	24.16 (6.08)
Purpose in life (PIL, n=754)	97.05 (16.35)	96.23 (17.40)	108.27 (14.52)	107.85 (17.66)
Three Years Post-Treatment Covariates				
Social support from family (SSQ, n=775)	8.02 (2.23)	7.49 (2.12)	8.52 (1.87)	8.67 (1.79)
Social support friends (SSQ, n=758)	7.19 (1.99)	6.77 (1.92)	7.40 (2.02)	7.74 (1.82)
AA involvement (AAI, n=776)	1.30 (1.70)	2.14 (2.07)	1.35 (1.70)	2.24 (2.30)
Self-efficacy (AASE, n=786)	2.49 (0.72)	3.12 (0.96)	3.08 (0.79)	3.86 (1.04)
Cigarettes/day (n=784)	14.62 (14.46)	12.74 (15.13)	11.90 (14.31)	10.96 (12.28)

Note. IPA=Important People and Activities; ADS=Alcohol Dependence Scale; PCQ=Process of Change Questionnaire; ASI=Addiction Severity Index; BDI=Beck Depression Inventory; STAX=State Trait Anger Expression Inventory; PIL=Purpose in Life Test; SSQ=Social Support Questionnaire; AAI=Alcoholics' Anonymous Involvement Scale; AASE=Alcohol Abstinence Self-Efficacy Scale. The BDI, STAX, and PIL were not administered at the 3-year post-treatment assessment time point.

Table 3.

Odds Ratios (95% Confidence Intervals) for Covariate Effects in Multinomial Logistic Regressions with Patient Characteristics predicting Odds of Membership in each Profile (Rows) versus the Reference Group (Columns)

Covariate – Time Period Assessed	Profile 1:	Profile 2:	Profile 3:	Profile 4:
	Low Functioning Frequent Heavy Drinking (Reference)	Low Functioning Infrequent Heavy Drinking (Reference)	High Functioning Occasional Heavy Drinking (Reference)	High Functioning Infrequent Non-Heavy Drinking (Reference)
Sex, male =1 – Baseline				
Versus Profile 1	--	1.26 (0.64, 2.48)	1.37 (0.68, 2.79)	1.77 (0.92, 3.41)
Versus Profile 2	0.80 (0.40, 1.57)	--	1.09 (0.54, 2.21)	1.41 (0.73, 2.71)
Versus Profile 3	0.73 (0.36, 1.48)	0.91 (0.45, 1.85)	--	1.29 (0.70, 2.38)
Versus Profile 4	0.57 (0.30, 1.08)	0.71 (0.37, 1.36)	0.78 (0.42, 1.42)	--
Treatment contrast, CBT =1 – Baseline				
Versus Profile 1	--	0.98 (0.50, 1.91)	1.13 (0.57, 2.26)	1.53 (0.77, 3.04)
Versus Profile 2	1.02 (0.52, 2.00)	--	1.16 (0.57, 2.35)	1.57 (0.81, 3.02)
Versus Profile 3	0.88 (0.44, 1.76)	0.86 (0.42, 1.76)	--	1.35 (0.72, 2.52)
Versus Profile 4	0.65 (0.33, 1.30)	0.64 (0.33, 1.23)	0.74 (0.40, 1.38)	--
Treatment contrast, MET =1 – Baseline				
Versus Profile 1	--	0.86 (0.43, 1.73)	1.72 (0.84, 3.50)	1.47 (0.75, 2.88)
Versus Profile 2	1.16 (0.58, 2.35)	--	2.00 (0.94, 4.24)	1.71 (0.87, 3.36)
Versus Profile 3	0.58 (0.29, 1.18)	0.50 (0.24, 1.06)	--	0.09 (0.05, 1.64)
Versus Profile 4	0.68 (0.35, 1.32)	0.58 (0.30, 1.14)	1.17 (0.62, 2.22)	--
Marital status, married =1 – Baseline				
Versus Profile 1	--	0.90 (0.50, 1.63)	0.76 (0.42, 1.36)	0.84 (0.47, 1.50)
Versus Profile 2	1.11 (0.62, 2.00)	--	0.84 (0.45, 1.55)	0.93 (0.53, 1.64)
Versus Profile 3	1.32 (0.73, 2.38)	1.19 (0.65, 2.20)	--	1.11 (0.07, 1.88)
Versus Profile 4	1.19 (0.67, 2.14)	1.08 (0.61, 1.90)	0.90 (0.53, 1.53)	--
Race, Non-Hispanic White =1 – Baseline				
Versus Profile 1	--	1.28 (0.58, 2.83)	0.75 (0.32, 1.79)	1.81 (0.83, 3.98)
Versus Profile 2	0.78 (0.35, 1.73)	--	0.59 (0.24, 1.46)	1.42 (0.68, 2.96)
Versus Profile 3	1.33 (0.56, 3.15)	1.70 (0.68, 4.20)	--	2.41 (1.09, 5.31)*
Versus Profile 4	0.55 (0.25, 1.21)	0.70 (0.35, 1.42)	0.42 (0.19, 0.91)*	--

Covariate – Time Period Assessed	Profile 1:	Profile 2:	Profile 3:	Profile 4:
	Low Functioning Frequent Heavy Drinking (Reference)	Low Functioning Infrequent Heavy Drinking (Reference)	High Functioning Occasional Heavy Drinking (Reference)	High Functioning Infrequent Non-Heavy Drinking (Reference)
Age – Baseline				
Versus Profile 1	--	1.01 (0.98, 1.04)	1.00 (0.97, 1.03)	1.03 (1.001, 1.06) *
Versus Profile 2	0.99 (0.96, 1.02)	--	0.99 (0.96, 1.02)	1.02 (0.99, 1.05)
Versus Profile 3	1.00 (0.97, 1.03)	1.01 (0.98, 1.04)	--	1.03 (1.00, 1.06)
Versus Profile 4	0.97 (0.94, 0.999) *	0.98 (0.95, 1.01)	0.97 (0.94, 1.00)	--
Alcohol dependence severity (ADS) – Baseline				
Versus Profile 1	--	1.00 (0.96, 1.04)	1.04 (0.99, 1.09)	0.98 (0.94, 1.02)
Versus Profile 2	1.00 (0.96, 1.04)	--	1.04 (0.99, 1.09)	0.98 (0.94, 1.02)
Versus Profile 3	0.96 (0.92, 1.01)	0.96 (0.92, 1.01)	--	0.94 (0.90, 0.98) **
Versus Profile 4	1.02 (0.98, 1.07)	1.02 (0.98, 1.07)	1.06 (1.02, 1.11) **	--
Social support for drinking (IPA) – Baseline				
Versus Profile 1	--	1.05 (0.81, 1.36)	0.98 (0.74, 1.28)	1.31 (1.003, 1.71) *
Versus Profile 2	0.96 (0.74, 1.24)	--	0.93 (0.69, 1.25)	1.25 (0.95, 1.64)
Versus Profile 3	1.03 (0.78, 1.35)	1.07 (0.80, 1.44)	--	1.34 (1.03, 1.75) *
Versus Profile 4	0.76 (0.59, 0.99) *	0.80 (0.61, 1.05)	0.74 (0.57, 0.97) *	--
Low risk drinking or abstinence – Treatment				
Versus Profile 1	--	0.43 (0.23, 0.80) **	0.80 (0.42, 1.51)	0.31 (0.16, 0.56) ***
Versus Profile 2	2.32 (1.25, 4.29) **	--	1.86 (0.97, 3.58)	0.71 (0.38, 1.31)
Versus Profile 3	1.26 (0.66, 2.36)	0.54 (0.28, 1.04)	--	0.38 (0.22, 0.67) **
Versus Profile 4	3.28 (1.78, 6.03) ***	1.41 (0.77, 2.60)	2.62 (1.50, 4.59) **	--
Coping (PCQ) – End of Treatment				
Versus Profile 1	--	0.42 (0.25, 0.71) **	1.22 (0.75, 1.99)	0.66 (0.39, 1.10)
Versus Profile 2	2.38 (1.41, 3.99) **	--	2.89 (1.65, 5.07) ***	1.56 (0.92, 2.63)
Versus Profile 3	0.82 (0.50, 1.34)	0.35 (0.20, 0.06) ***	--	0.54 (0.32, 0.90) *
Versus Profile 4	1.53 (0.91, 2.55)	0.64 (0.38, 1.08)	1.86 (1.13, 3.04) *	--
Psychiatric severity (ASD) – 1 year				
Versus Profile 1	--	0.78 (0.65, 0.93) **	1.03 (0.82, 1.28)	1.03 (0.81, 1.31)

Covariate – Time Period Assessed	Profile 1:	Profile 2:	Profile 3:	Profile 4:
	Low Functioning Frequent Heavy Drinking (Reference)	Low Functioning Infrequent Heavy Drinking (Reference)	High Functioning Occasional Heavy Drinking (Reference)	High Functioning Infrequent Non-Heavy Drinking (Reference)
Versus Profile 2	1.29 (1.07, 1.55)**	--	1.32 (1.06, 1.66)*	1.33 (1.03, 1.71)*
Versus Profile 3	0.97 (0.78, 1.21)	0.77 (0.60, 0.95)*	--	1.00 (0.78, 1.29)
Versus Profile 4	0.97 (0.77, 1.23)	0.75 (0.59, 0.96)*	1.00 (0.78, 1.27)	--
Depression (BDI) – 1 year				
Versus Profile 1	--	1.04 (0.98, 1.09)	1.03 (0.97, 1.10)	1.07 (1.004, 1.14)*
Versus Profile 2	0.96 (0.91, 1.02)	--	0.99 (0.93, 1.06)	1.03 (0.96, 1.11)
Versus Profile 3	0.97 (0.91, 1.03)	1.01 (0.94, 1.08)	--	1.04 (0.97, 1.11)
Versus Profile 4	0.93 (0.87, 0.996)*	0.97 (0.91, 1.04)	0.96 (0.90, 1.03)	--
Anger (STAX) – 1 year				
Versus Profile 1	--	0.99 (0.94, 1.04)	1.06 (1.01, 1.12)*	1.08 (1.03, 1.14)*
Versus Profile 2	1.01 (0.96, 1.06)	--	1.07 (1.01, 1.13)*	1.09 (1.04, 1.15)**
Versus Profile 3	0.94 (0.89, 0.99)*	0.93 (0.88, 0.99)*	--	1.02 (0.97, 1.07)
Versus Profile 4	0.92 (0.88, 0.97)*	0.92 (0.87, 0.96)**	0.98 (0.94, 1.03)	--
Purpose in Life (PIL) – 1 year				
Versus Profile 1	--	1.01 (0.99, 1.03)	0.98 (0.95, 0.997)*	0.99 (0.97, 1.01)
Versus Profile 2	0.99 (0.97, 1.01)	--	0.97 (0.94, 0.99)**	0.98 (0.96, 1.01)
Versus Profile 3	1.03 (1.003, 1.05)*	1.04 (1.01, 1.06)**	--	1.02 (0.99, 1.04)
Versus Profile 4	1.01 (0.99, 1.03)	1.02 (0.99, 1.04)	0.99 (0.96, 1.01)	--
Social support from family (SSQ) – 3 years				
Versus Profile 1	--	1.11 (0.96, 1.29)	0.95 (0.81, 1.11)	0.84 (0.80, 0.996)*
Versus Profile 2	0.90 (0.77, 1.04)	--	0.85 (0.72, 1.00)	0.75 (0.64, 0.88)***
Versus Profile 3	1.06 (0.90, 1.24)	1.17 (1.00, 1.38)	--	0.88 (0.74, 1.05)
Versus Profile 4	1.19 (1.004, 1.42)*	1.33 (1.14, 1.55)***	1.13 (0.96, 1.34)	--
Social support from friends (SSQ) – 3 years				
Versus Profile 1	--	1.11 (0.93, 1.31)	1.00 (0.84, 1.19)	0.86 (0.73, 1.03)
Versus Profile 2	0.90 (0.76, 1.07)	--	0.90 (0.76, 1.07)	0.78 (0.66, 0.92)**
Versus Profile 3	1.00 (0.84, 1.18)	1.11 (0.93, 1.31)	--	0.86 (0.73, 1.01)

Covariate – Time Period Assessed	Profile 1: Low Functioning Frequent Heavy Drinking (Reference)	Profile 2: Low Functioning Infrequent Heavy Drinking (Reference)	Profile 3: High Functioning Occasional Heavy Drinking (Reference)	Profile 4: High Functioning Infrequent Non-Heavy Drinking (Reference)
Versus Profile 4	1.16 (0.98, 1.37)	1.28 (1.09, 1.51)**	1.16 (0.99, 1.36)	--
AA involvement (AAD) – 3 years				
Versus Profile 1	--	0.83 (0.70, 0.97)*	0.86 (0.72, 1.04)	0.75 (0.62, 0.89)**
Versus Profile 2	1.21 (1.03, 1.43)*	--	1.04 (0.89, 1.23)	0.90 (0.78, 1.04)
Versus Profile 3	1.16 (0.96, 1.40)	0.96 (0.81, 1.13)	--	0.87 (0.85, 0.998)*
Versus Profile 4	1.34 (1.12, 1.60)**	1.11 (0.96, 1.28)	1.16 (1.002, 1.33)*	--
Self-efficacy (AASE) – 3 years				
Versus Profile 1	--	0.41 (0.29, 0.57)***	0.55 (0.40, 0.74)***	0.20 (0.14, 0.29)***
Versus Profile 2	2.46 (1.75, 3.46)***	--	1.34 (0.98, 1.83)	0.50 (0.36, 0.69)***
Versus Profile 3	1.83 (1.35, 2.49)***	0.75 (0.55, 1.02)	--	0.37 (0.28, 0.49)***
Versus Profile 4	4.94 (3.43, 7.11)***	2.01 (1.46, 2.77)***	2.69 (2.04, 3.55)***	--
Cigarettes per day – 3 years				
Versus Profile 1	--	1.02 (1.002, 1.05)*	1.01 (0.99, 1.03)	1.03 (1.008, 1.05)**
Versus Profile 2	0.98 (0.96, 0.998)*	--	0.99 (0.97, 1.01)	1.01 (0.99, 1.03)
Versus Profile 3	0.99 (0.97, 1.01)	1.01 (0.99, 1.03)	--	1.02 (1.00, 1.04)
Versus Profile 4	0.97 (0.95, 0.99)**	0.99 (0.97, 1.01)	0.98 (0.96, 1.00)	--

Note.

* $p < .05$;

** $p < .01$;

*** $p < .001$.

All covariates listed in Table 2 were included in the models. IPA=Important People and Activities; ADS=Alcohol Dependence Scale; PCQ=Process of Change Questionnaire; ASI=Addiction Severity Index; BDI=Beck Depression Inventory; STAX=State Trait Anger Expression Inventory; PIL=Purpose in Life Test; SSQ=Social Support Questionnaire; AAI=Alcoholics' Anonymous Involvement Scale; AASE=Alcohol Abstinence Self-Efficacy Scale. The BDI, STAX, and PIL were not administered at the 3-year post-treatment assessment time point.