Received: 17 September 2024 | Accepted: 27 February 2025

DOI: 10.1111/acer.70032

ALCOHOL CLINICAL & EXPERIMENTAL RESEARCH ISBRA

RESEARCH ARTICLE

Subgroups of anxiety and depression trajectories during early abstinence in alcohol use disorder

Manesh Gopaldas[1,2] | Elizabeth A. Flook[1,3] | Nick Hayes[4] | Margaret M. Benningfield[1] | Jennifer Urbano Blackford[1,5]

[1]Department of Psychiatry and Behavioral Sciences, Vanderbilt University Medical Center, Nashville, Tennessee, USA

[2]Columbia University Irving Medical Center, New York State Psychiatric Institute, New York, New York, USA

[3]Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, USA

[4]Cumberland Heights Foundation, Nashville, Tennessee, USA

[5]University of Nebraska Medical Center, Munroe-Meyer Institute, Omaha, Nebraska, USA

Correspondence
Jennifer Urbano Blackford, Munroe-Meyer Institute, University of Nebraska Medical Center, 6902 Pine Street, Omaha, NE 68016, USA.
Email: jblackford@unmc.edu

Funding information
National Institute on Alcohol Abuse and Alcoholism, Grant/Award Number: F30AA027418, P60AA031124 and R01AA029127; National Institute on Drug Abuse, Grant/Award Number: T32DA007294

Abstract

Background: Symptoms of anxiety and depression are common during early abstinence and can precipitate relapse. Previous studies show that, on average, anxiety and depression symptoms are typically elevated at treatment intake and decline rapidly during the first month. However, alcohol use disorder (AUD) is clinically heterogeneous, and it remains unknown whether there are distinct subgroups in the trajectories of anxiety and depression symptoms or whether all individuals show the characteristic decline.

Methods: This study aimed to identify and characterize anxiety and depression trajectories in a large sample ($n = 1005$) of individuals with AUD during early abstinence. Deidentified electronic medical record data were obtained from a community substance use treatment program. Anxiety and depression symptoms were assessed weekly using the GAD-7 and PHQ-9 scales, respectively. Latent growth curve analyses were used to identify subgroups.

Results: Three subgroups were identified for both anxiety and depression trajectories: low, high, and sustained. The low trajectory subgroup comprised the majority of individuals (73% for anxiety, 70% for depression) and showed rapid symptom reduction. The high trajectory symptom subgroup (22% for anxiety, 24% for depression) showed a slower decrease in symptoms. In comparison, the sustained trajectory symptom subgroup (5% for anxiety, 6% for depression) maintained high reported symptoms throughout treatment. The three trajectory subgroups differed in age, sex, co-occurring mental health and substance use disorders, and PTSD symptom severity scores.

Conclusion: These findings provide strong evidence for subtypes based on anxiety and depression symptom trajectories in early abstinence. Early identification of individuals in the sustained trajectory subgroup could improve treatment outcomes and reduce relapse risk.

KEYWORDS
comorbidity, early abstinence, heterogeneity, negative affect

INTRODUCTION

Alcohol use disorder (AUD) is the most common substance use disorder (SUD) in the United States (Substance Abuse and Mental Health Services Administration, 2022) and a leading contributor to the global disease burden (Griswold et al., 2018). AUD is associated with a myriad of adverse health consequences, and rising rates of excessive drinking have contributed to an increase in alcohol-related deaths (White et al., 2022). Despite the availability of treatments for AUD (Witkiewitz et al., 2019), more than 50% of people treated for an AUD relapse within the first 6 months to 1 year (Durazzo & Meyerhoff, 2017; Kirshenbaum et al., 2009; Maisto et al., 2006), highlighting the challenges of maintaining abstinence and achieving long-term recovery.

Chronic alcohol use leads to neuroadaptations of the reward and stress systems. When alcohol use is abruptly stopped, the reward system's adaptations result in depressive-like behaviors such as anhedonia and amotivation (Davidson et al., 1995; Volkow et al., 2007). In parallel, enhanced recruitment of stress circuits in the extended amygdala triggers anxiety-like behaviors and emotional distress (Koob & Mason, 2016). Together, these neuroadaptations collectively produce a chronic stress-like state that has been coined hyperkatifeia and referred to as the dark side of addiction (Koob, 2022). During early abstinence in humans—the period following an abrupt reduction or cessation in drinking—negative affect symptoms of anxiety and depression emerge and can precipitate relapse (Heilig et al., 2010; Witkiewitz & Villarroel, 2009; Zywiak et al., 1996). Thus, a significant barrier to sustained abstinence is the increased anxiety and depressive symptoms commonly observed in early abstinence (Ottonello et al., 2019; Sullivan, 2020).

Initial studies of negative affect in early abstinence showed that anxiety and depression symptoms are typically elevated at treatment entry and significantly reduced or resolved by the end of treatment, usually 1 month (Gallagher et al., 2018; Ludenia et al., 1984; Petit et al., 2020; Roberts et al., 1999). Several other studies have assessed anxiety or depression more frequently (e.g., weekly) throughout treatment in academic or hospital inpatient programs and found sharp and steady decreases in average anxiety and depression symptoms during treatment (Brown et al., 1991; Brown & Schuckit, 1988; Driessen et al., 2001; Liappas et al., 2002; Voltaire-Carlsson et al., 1996). Together, these studies provide evidence that anxiety and depression symptoms are elevated at treatment entry and decrease significantly by the end of treatment, approaching levels seen in the general population. Some limitations of previous studies are that they recruited only from academic or hospital inpatient settings and that the participants were largely (or only) men. In addition, the small sample sizes precluded investigations of heterogeneity; therefore, it remains unknown whether there are individual differences in the time courses of negative affect.

AUD has long been recognized as a highly heterogeneous disorder (Carroll, 2021). Several of the earlier studies investigated the role of cooccurring anxiety or depressive disorder as one approach to exploring heterogeneity. Brown et al. found that men with a panic disorder or generalized anxiety disorder had higher state anxiety scores throughout treatment but similar rates at discharge (Brown et al., 1991) and that men with a cooccurring affective disorder displayed more persistent depressive symptoms than those without (Brown et al., 1988). Driessen et al. (2001) showed that trait anxiety scores declined less in individuals with a lifetime history of both anxiety and depression, but there were no differences in depression scores.

More recent efforts, such as the National Institute on Alcohol and Alcoholism (NIAAA) Addictions Neuroclinical Assessment (Kwako et al., 2016), have renewed a focus on exploring heterogeneity in AUD. The Addictions Neuroclinical Assessment (ANA) proposed a framework for developing neuroclinical measures to characterize the heterogeneity in AUD, including core domains of executive function, negative emotionality, and incentive salience. Several recent studies have provided excellent examples of the potential benefit of investigating heterogeneity in SUDs by identifying subtypes in moderate-size samples (Drossel et al., 2023; Schmid et al., 2021; Zhao et al., 2021). For instance, Drossel et al. (2023) identified three subtypes based on one time point of phenotypic data in people with a past SUD in a community sample ($n = 593$): reward, cognitive, and relief. The relief subtype (19.6%) had significantly higher scores on measures of internalizing symptoms, trait negative affect, and general psychiatric symptoms, consistent with hyperkatifeia. Robinson et al. (2024) tested for subgroups in people receiving residential treatment for an SUD ($n = 554$) using two time points (intake, 3 months). They identified five subtypes: moderate severity-stable, high severity-most improved, low severity-improved, moderate severity-improved, and moderate severity-declined. The moderate severity-stable (9.9%) and moderate severity-declined (8.7%) subtypes both had elevated negative affect that remained stable or worsened at 3 months. Thus, both studies identified a subtype consistent with sustained or worsening negative affect. However, both studies examined SUD broadly, not AUD specifically, and had only one or two time points of data. Therefore, an essential gap in the field is whether subtypes can be identified in AUD and whether dense sampling (e.g., multiple time points) can precisely identify distinct trajectories.

The goal of this study is to fill this gap by examining weekly anxiety and depression trajectories in a large sample of individuals with AUD in early abstinence receiving treatment in a community substance use treatment program. Our aims were (1) to characterize the time course of negative affect (anxiety and depression) during the first 6 weeks of abstinence from alcohol; (2) to determine whether there are subgroups that differ in the time course of negative affect; and (3) to describe characteristics, including sex and co-occurring disorders, in the subgroups. Identifying subgroups by negative affect time course during early abstinence could have implications for treatments and thus could reduce the risk of relapse.

MATERIALS AND METHODS

Participants

For this study, we analyzed deidentified data obtained from the electronic medical records of people entering treatment at a large community substance use treatment program. The treatment program was a private facility that accepts commercial insurance and self-pay. People in the program received a variety of evidence-based treatments, including individual therapy, group therapy, and medications for alcohol use disorder based on their individual treatment plans. Information on specific treatments was not available in the deidentified dataset.

The dataset was comprised of all people who had a primary AUD and treatment admission between January 1, 2020, and December 30, 2020. The treatment facility had recently implemented the collection of weekly anxiety and depression symptom scores. Anxiety and depression scores up to 45 days from treatment entry were included in the dataset. People who did not have an anxiety or depression score within the first 2 weeks of treatment or only had one score were excluded. The final dataset included 1001 with anxiety scores and 1005 individuals with depression scores.

Measures

Anxiety and depression symptoms were measured initially, usually in the first week of treatment, and then approximately weekly. Anxiety was assessed with the GAD-7 (Spitzer et al., 2006), a reliable and valid tool for measuring anxiety. Scores range from 0 to 21, with a clinical cutoff score of ≥10. Depression was measured with the Patient Health Questionnaire-9 (PHQ-9), a validated tool used to assess depression severity (Kroenke et al., 2001). Scores range from 0 to 27, with a clinical cutoff score of ≥10.

PTSD symptoms were measured one time, usually in the first week of treatment, with the PTSD Checklist for DSM-5 (PCL-5) (Blevins et al., 2015). Scores range from 0 to 80, with a clinical cutoff score of ≥31.

The demographic and clinical characteristics from the electronic medical record included age, self-reported gender (Man, Woman), self-reported race/ethnicity (White, Black, Hispanic/Latino, or Other), and co-occurring mental health and SUDs. The presence or absence of a current co-occurring mental health or SUD was determined during a clinical interview performed by a trained clinician at the treatment facility. The diagnosis reflects the current diagnosis; lifetime history was not provided in the deidentified dataset.

Data analysis

To determine whether there were trajectory subgroups in the time course of anxiety or depression symptoms, latent growth curve analyses (LGCA) were performed using the *hlme* function in the *lcmm* package (Proust-Lima et al., 2017) in R (R Core Team, 2024). Although anxiety and depression scores are often correlated, we analyzed them separately based on previous findings that there may be important differences (c.f. Driessen et al., 2001). In the LGCA, we modeled weekly anxiety and depression scores during treatment. Anxiety and depression scores were modeled as fixed effects and analyzed as a function of time (days = date of questionnaire completion − admission date). The *hmle* function uses maximum likelihood estimates to identify the latent classes based on the available scores for each participant; therefore, differences in the number of measurements are automatically handled within the model. However, to investigate the impact of limited numbers of measurements, we also performed a sensitivity analysis on a subsample of participants that had three or more time points of anxiety ($n = 728$) or depression ($n = 734$) scores.

LGCA were performed to test for models that included between 1 and 7 subgroups. An optimal number of subgroups was determined using the Akaike information criterion (AIC) and Bayesian information criterion (BIC) indices. A ΔBIC was computed to assess fit improvement for each more complex model, with negative scores indicating better fit. Each model was also assessed for entropy, with values ≥0.80 suggesting good model class assignments. To prevent a final model solution with very small subgroups, we used an additional criterion that the smallest group must be ≥5% (of the total *N* included in the model).

Once the optimal number of subgroups was identified, ANOVAs and chi-square analyses were used to characterize the different subgroups. We tested for differences by sex, race, age, presence of a co-occurring mental health disorder, presence of a co-occurring substance use disorder, and PTSD symptom scores (PCL-5). For the mental health and substance use disorders, we only performed these analyses for disorders with at least 5% prevalence in the sample to ensure sufficient sample sizes within each cell. The disorders that met this prevalence criteria were anxiety disorders, depressive disorders, PTSD, cannabis use disorder, and opioid use disorder (Table 1). Post hoc analyses were used to identify significant effects between subgroups.

To determine whether the association between the anxiety and depression subgroup assignments was similar, we performed chi-square analyses, followed by chi-square decomposition post hoc analyses. An $\alpha < 0.05$ was considered statistically significant. All analyses were completed in R (R Core Team, 2024).

RESULTS

Sample characteristics

Table 1 shows baseline demographic and clinical characteristics for the overall sample of individuals with AUD in early abstinence. The sample was predominantly White (90%) and 68% male, with an average age of 42.6 years (SD = 12.6).

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TABLE 1 Demographic and clinical characteristics for entire sample.

Characteristic	*N*	%
Female	320	31.8
Male	685	68.2
Race/ethnicity		
White/Caucasian	906	90.1
Black/African American	53	5.3
Hispanic/Latino	17	1.7
Other	29	2.9
Cooccurring mental health disorders		
Depressive disorders	341	33.9
Anxiety disorders	260	25.9
Posttraumatic stress disorder	62	6.2
Bipolar disorder	40	3.9
Attention-deficit/hyperactivity disorder	36	3.6
Cooccurring substance use disorders		
Amphetamine use disorder	23	2.3
Cannabis use disorder	146	14.5
Cocaine use disorder	49	4.9
Opioid use disorder	76	7.6
Sedative, hypnotic, or anxiolytic disorders	51	5.1
Stimulant use disorder	16	1.6
Tobacco use disorders	45	4.5

Trajectory subgroups

We first characterized the time course of anxiety and depression symptoms across the entire sample. Anxiety and depression symptoms were initially elevated and decreased to low symptoms by Week 2 (Figure 1A,C). Plots of individual anxiety and depression trajectories are shown in Figure S1.

The LGCA revealed significant subgroups based on symptom trajectories for both anxiety and depression (Figure 1B,D). A three-factor solution had the best fit based on AIC, BIC, ΔBIC, and entropy (Table 2). For anxiety, the subgroups were "low" (73%), "high" (22%), and "sustained" (5%). For depression, the subgroups were "low" (70%), "high" (24%), and "sustained" (6%). In general, the low group started with lower scores and had a rapid decline in symptoms, the high group had higher scores with a slower decline over time, and the sustained group had high scores with minimal decline over time.

The sensitivity analyses performed on the subset of data for participants who had three or more time points of data also resulted in three-factor solutions for both anxiety and depression scores. The three subgroups had the same trajectory pattern as the models with the full dataset. See Appendix S1 for model fit indices and figures.

Anxiety trajectory subgroups

Table 3 shows the demographic and clinical data by anxiety trajectory subgroup. For the anxiety trajectory subgroups, age had a significant effect ($p=0.001$). People in the low trajectory subgroup were older than those in the high trajectory ($p=0.0007$) and sustained trajectory subgroups ($p=0.0001$). There were no significant differences between subgroups by sex ($p=0.10$) or race ($p=0.34$).

The percentage of cooccurring disorders by anxiety subgroup is shown in Figure 2. Anxiety disorders differed across anxiety trajectory subgroups ($p<0.0001$). There were significant differences between all three trajectory subgroups. More people had an anxiety disorder in the sustained trajectory subgroup relative to the high trajectory subgroup ($p=0.04$) and the low anxiety subgroup ($p<0.0001$); there were also more anxiety disorders in the high trajectory relative to low trajectory subgroups ($p=0.0008$).

Depressive disorders also differed across subgroups ($p<0.0001$). People in the high and sustained trajectory subgroups were more likely to have a depressive disorder compared to the low trajectory subgroup ($p<0.0001$, $p=0.0004$).

PTSD differed across anxiety subgroups ($p=0.0004$). People in the high and sustained trajectory subgroups were more likely to have PTSD compared to those in the low trajectory subgroups ($p=0.003$, $p=0.006$).

Cannabis use disorder differed across anxiety subgroups ($p=0.03$). A co-occurring cannabis use disorder was more common in the sustained and high trajectory subgroups relative to the low trajectory subgroup ($p=0.03$, $p=0.05$). There were no significant differences for opioid use disorders.

The PTSD symptom scores by anxiety subgroup are shown in Figure 3. PTSD symptom scores also differed by anxiety subgroup ($p<0.001$). PTSD scores differed between all trajectory subgroups. People in the sustained trajectory subgroup had higher PTSD scores compared to the high trajectory and low trajectory subgroups ($p<0.0001$, $p=0.0002$). People in the high trajectory subgroup also had higher PTSD scores than those in the low trajectory subgroup ($p<0.0001$).

Depression trajectory subgroups

Table 4 shows the demographic and clinical data for each depression trajectory subgroup. For the depression trajectory subgroups, age had a significant effect ($p=0.04$). People in the low trajectory subgroup were older than people in the high trajectory subgroup ($p=0.04$), but not than the sustained trajectory subgroup ($p=0.08$). There were also significant differences in sex ($p=0.005$). There was a higher proportion of women in the high trajectory subgroup than in the low trajectory subgroup ($p=0.0001$). There were no significant differences by race ($p=0.36$).

The percentage of cooccurring disorders by depression subgroup is shown in Figure 2. Depressive disorders differed across depression subgroups ($p<0.0001$). More people had a depressive disorder in the sustained and high trajectory subgroups relative to the low trajectory subgroup (both $p<0.0001$).

Anxiety disorders also differed across depression subgroups ($p=0.01$). More people had an anxiety disorder in the sustained and

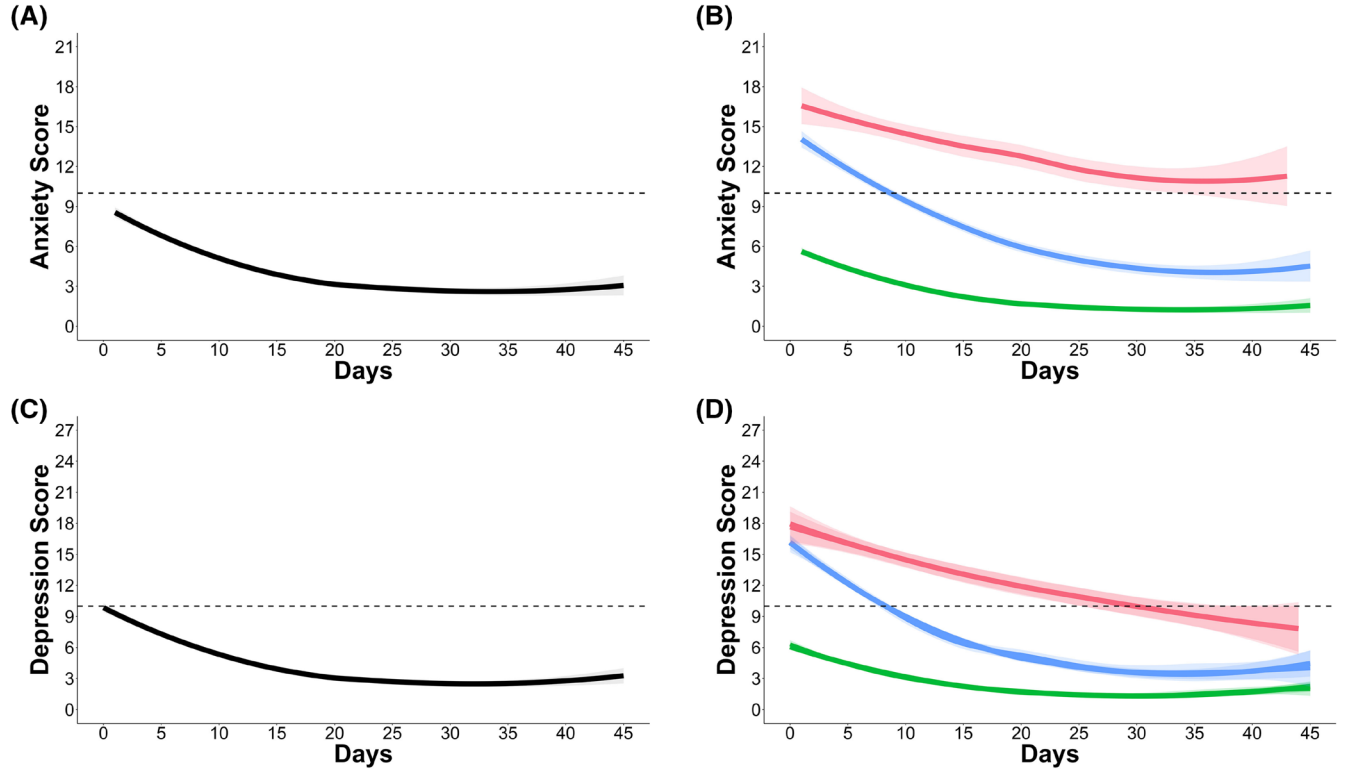

FIGURE 1 Trajectories of anxiety and depression during early abstinence in AUD. The figure panels illustrate the average trajectory of symptoms with confidence intervals for: (A) anxiety symptom scores for the entire sample; (B) anxiety symptom scores for the three subgroups: green = low trajectory, blue = high trajectory, red = sustained trajectory; (C) depression symptom scores for entire sample; (D) depression symptom scores for the three subgroups: green = low trajectory, blue = high trajectory, red = sustained trajectory. The dotted lines represent clinically significant levels of anxiety or depression symptoms based on standard cut-off scores.

TABLE 2 Fit statistics for anxiety and depression symptom scores based on LGCA models.

Number of subgroups	LL	AIC	BIC	ΔBIC	Entropy	Smallest group %
Anxiety symptom scores						
1	−9791.86	19,595.73	19,625.12		1	100
2	−9791.86	19,601.73	19,645.82	20.70	0.00	39
3	**−9639.72**	**19,303.44**	**19,362.22**	**−283.60**	**0.80**	**5**
4	−9624.99	19,279.97	19,353.45	−8.77	0.53	8
5	−9577.17	19,190.34	19,278.52	−74.93	0.79	3
6	−9542.67	19,127.33	19,230.21	−48.31	0.80	2
7	−9577.17	19,202.34	19,319.91	89.71	0.59	4
Depression symptom scores						
1	−10,085.15	20,182.29	20,211.71		1.00	100
2	−10,085.15	20,188.29	20,232.42	20.71	0.00	39
3	**−9956.27**	**19,936.55**	**19,995.38**	**−237.04**	**0.76**	**7**
4	−9918.57	19,867.13	19,940.67	−54.71	0.53	6
5	−9918.57	19,873.13	19,961.38	20.71	0.44	6
6	−9886.84	19,815.69	19,918.64	−42.74	0.54	5
7	−9886.84	19,821.69	19,939.35	20.71	0.45	5

Note: Bolded values indicate the model with the best fit indices.

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TABLE 3 Demographic and clinical characteristics by anxiety trajectory subgroup.

	Low		High		Sustained		Subgroup comparison
Characteristic	***N***	***M* (SD)**	***N***	***M* (SD)**	***N***	***M* (SD)**	***p*-Value**
Age	731	43.6 (12.4)	219	40.4 (12.5)	51	36.8 (11.6)	<0.001[c]
Anxiety score (first)	731	4.40 (3.79)	219	12.5 (4.11)	51	15.5 (4.2)	<0.001[a]
Depression score (first)	731	5.3 (4.4)	219	12.7 (5.2)	51	14.7 (5.8)	<0.001[a]
PTSD score	704	24.7 (17.3)	209	38.1 (19.7)	49	48.7 (17.1)	<0.001[a]
	N	**%**	***N***	**%**	***N***	**%**	***p*-Value**
Sex							
Female	221	30.2	76	34.7	22	43.1	0.10
Male	510	69.8	143	65.3	29	56.9	
Race/ethnicity							
White	659	90.2	195	89.0	49	96.0	0.34
Black	43	5.9	9	4.1	1	2.0	
Hispanic/Latino	12	1.6	5	2.3	0	0.0	
Other	17	2.3	10	4.6	1	2.0	
Mental health disorders							
Depressive disorders	214	29.3	100	45.7	27	52.9	<0.001[a]
Anxiety disorders	162	22.2	73	33.3	25	49.0	<0.001[b]
PTSD	33	4.5	21	9.6	8	15.7	<0.001[b]
Substance use disorders							
Cannabis use disorder	94	12.9	40	18.3	12	23.5	0.03[b]
Opioid use disorder	46	6.3	24	11.0	5	9.8	0.06

[a]Low subgroup < high subgroup < sustained subgroup.

[b]Low subgroup < high subgroup = sustained subgroup.

[c]Low subgroup > high = sustained subgroups.

high trajectory subgroups relative to the low trajectory subgroup ($p = 0.02$, $p = 0.03$).

PTSD differed across depression subgroups ($p = 0.0018$). People in the sustained and high trajectory subgroups were more likely to have PTSD compared to those in the low trajectory subgroup ($p = 0.006$, $p = 0.004$).

Cannabis use disorder differed across depression subgroups ($p = 0.04$). A cooccurring cannabis use disorder was more common in the sustained and high trajectory subgroups compared to the low trajectory subgroup (both $p = 0.05$).

Opioid use disorder also differed across depression subgroups ($p = 0.02$). A cooccurring opioid use disorder is more common in the sustained and high trajectory subgroups than in the low trajectory subgroup ($p = 0.05$, $p = 0.01$).

The PTSD symptom scores by depression subgroup are shown in Figure 3. PTSD symptom scores also differed by depression subgroup ($p < 0.001$). PTSD scores differed between all trajectory subgroups. People in the sustained trajectory subgroup had higher PTSD scores relative to those in the high trajectory and low trajectory subgroups ($p = 0.003$, $p < 0.0001$). Also, people in the high trajectory subgroup had higher PTSD scores than those in the low trajectory subgroup ($p < 0.0001$).

Comparison of anxiety and depression subgroup assignments

We analyzed anxiety and depression symptom trajectories separately based on prior literature. However, given that anxiety and depression are often correlated, we also performed a chi-square analysis to examine the association between the subgroup assignments. There was a significant association between the anxiety and depression subgroups ($\phi = 0.72$; $p < 0.0001$). Subgroup counts and percentages are provided in Table 5. For the low trajectory subgroup, 87% of those in the low trajectory anxiety subgroup were also in the low trajectory depression subgroup. For the high trajectory subgroups, 60% of those in the high trajectory anxiety subgroup were also in the high trajectory depression subgroup. For the sustained trajectory subgroups, 53% of those in the sustained trajectory anxiety group were also in the sustained trajectory depression group. Thus, the significant association between anxiety and depression subgroups was driven mainly by people who were in both the low anxiety and depression subgroups. There was less overlap for the high and sustained trajectory subgroups. Although the high and sustained trajectory subgroups both had high initial symptom scores, the pattern of the trajectories differed, and this may be important for predicting long-term outcomes.

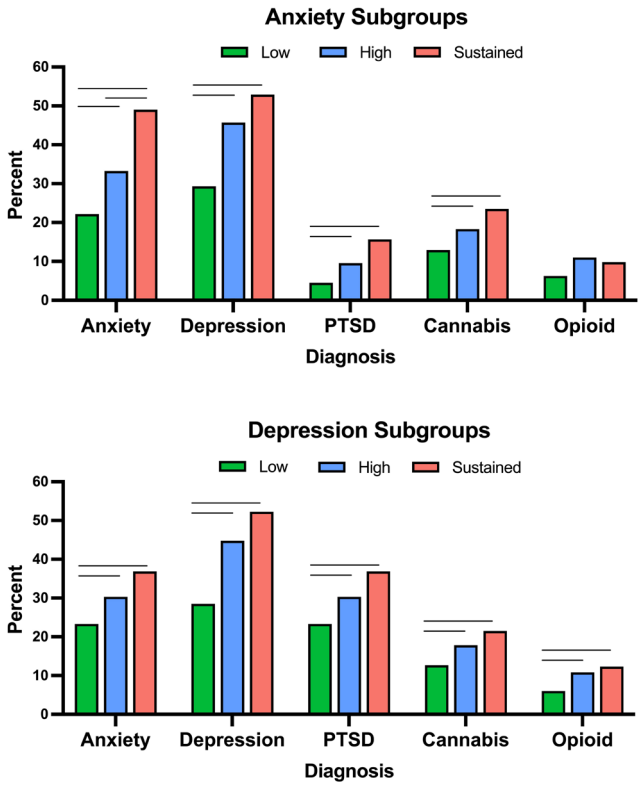

FIGURE 2 Percentage of cooccurring disorders by anxiety and depression subgroup. The figure shows the percentages of people in each subgroup with cooccurring mental health and substance use disorders. The horizontal lines show statistically significant differences between subgroups (all $p < 0.05$).

Distinguishing between subgroups

While the previous analyses focused on characterizing the three subgroups, early identification of those people who display a sustained trajectory relative to the high trajectory could have clinical implications for those who would benefit from additional treatment explicitly focused on anxiety or depression. Therefore, we performed a post hoc logistic regression analysis to compare the high trajectory relative to the sustained trajectory subgroups for both anxiety and depression. The model included all variables from the previous analyses plus initial anxiety and depression scores based on potential clinical utility as early predictors. For the anxiety subgroups, the overall logistic regression was significant (AUC = 0.76, $R^2 = 0.14$, $p < 0.001$). There were two significant predictors: initial anxiety score (odds ratio = 1.24, CI = 1.10–1.38, $p = 0.0002$) and initial PTSD score (odds ratio = 1.02, CI = 1.002–1.044, $p = 0.02$). For the depression subgroups, the overall logistic regression was significant (AUC = 0.70, $R^2 = 0.08$, $p = 0.03$). There were two significant predictors: initial depression score (odds ratio = 1.10, CI = 1.01–1.20, $p = 0.05$) and initial PTSD score (odds ratio = 1.02, CI = 1.003–1.04, $p = 0.02$). Thus, for both anxiety and depression, initial anxiety or depression symptom scores and initial PTSD symptom scores were significant predictors of trajectory subgroup.

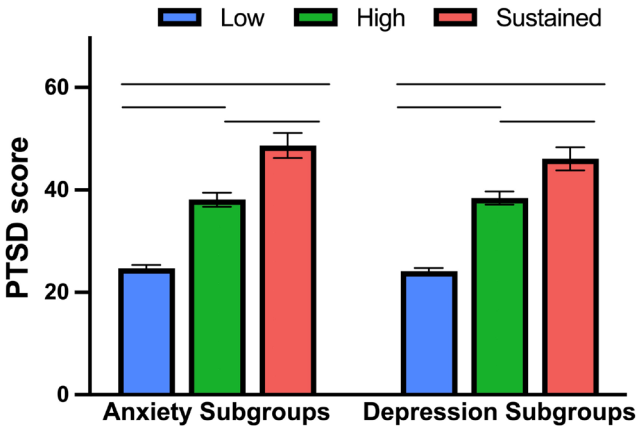

FIGURE 3 PTSD scores by anxiety and depression subgroups. The figure shows PTSD symptom scores (PCL-5) means and standard errors by anxiety and depression trajectory subgroups. The horizontal lines show statistically significant differences between subgroups (all $p < 0.05$).

DISCUSSION

In this study, we investigated whether there are subgroups in anxiety or depression symptom scores across early abstinence in a large sample of people receiving treatment for a primary AUD in a community substance use treatment facility. There were three main findings. First, we discovered three distinct trajectories of anxiety and depression symptoms: low trajectory, high trajectory, and sustained trajectory. Second, we discovered that age, sex (depression only), co-occurring mental health disorders, co-occurring substance use disorders, and PTSD symptom scores differed across subgroups. Third, we identified that both initial anxiety and depression symptom scores and PTSD symptom scores were able to significantly distinguish between the two high and sustained subgroups. Together, these findings provide new insights into the early abstinence phase of AUD. Previous studies have reported initially elevated anxiety and depression that resolve quickly during the first few weeks of abstinence. Our findings highlight that while this pattern is common, about 30% of people had high initial anxiety and depression scores that either reduced more slowly or remained high-throughout treatment. Thus, we provide initial evidence for distinct subtypes in negative affect during early abstinence.

The anxiety and depression time courses, across the whole sample, showed early elevations in anxiety and depression that reduced to low levels relatively quickly, consistent with previous studies (Brown et al., 1991; Brown & Schuckit, 1988; Gallagher et al., 2018; Liappas et al., 2002). This pattern was characteristic of the low subgroup, the largest subgroup for both the anxiety and depression trajectory analyses. Given that symptoms in this group resolved relatively quickly, one possibility is that this group represents the conceptualized negative affect phase of addiction, where anxiety and depression emerge in the context of neurobiological changes. Another possibility is that the low subgroup reflected people with specific characteristics, such as older age, lower rates of mental

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TABLE 4 Demographic and clinical characteristics by depression trajectory subgroup.

	Low		High		Sustained		Subgroup comparison
Characteristic	**N**	***M* (SD)**	**N**	***M* (SD)**	**N**	***M* (SD)**	***p*-Value**
Age	699	43.2 (12.4)	241	41.3 (12.3)	65	40.4 (15.0)	0.04[c]
Anxiety score (first)	696	4.4 (3.9)	240	11.7 (4.8)	65	13.7 (4.5)	<0.001[a]
Depression score (first)	699	4.5 (3.4)	241	13.5 (4.4)	65	15.9 (5.0)	<0.001[a]
PTSD score	674	24.1 (17.1)	232	38.4 (19.4)	60	46.1 (17.4)	<0.001[a]
	N	**%**	***N***	**%**	***N***	**%**	***p*-Value**
Sex							
Female	197	28.2	100	41.5	23	35.4	0.001[d]
Male	502	71.8	141	58.5	42	64.6	
Race/ethnicity							
White	626	89.6	222	92.1	58	89.2	0.36
Black	42	6.0	8	3.3	3	4.6	
Hispanic/Latino	12	1.7	5	2.1	0	0.0	
Other	19	2.7	6	2.5	4	6.2	
Mental health disorders							
Depressive disorders	199	28.5	108	44.8	34	52.3	<0.001[b]
Anxiety disorders	163	23.3	73	30.3	24	36.9	0.01[b]
PTSD	31	4.4	23	9.5	8	12.3	0.002[b]
Substance use disorders							
Cannabis use disorder	89	12.7	43	17.8	14	21.5	0.04[b]
Opioid use disorder	42	6.0	26	10.8	8	12.3	0.02[b]

Abbreviations: *M*, mean; SD, standard deviation.

[a]Low trajectory subgroup < high trajectory subgroup < sustained trajectory subgroup.

[b]Low trajectory subgroup < high trajectory subgroup = sustained trajectory subgroup.

[c]Low trajectory subgroup = sustained trajectory subgroup > high trajectory subgroups.

[d]Low trajectory > high trajectory subgroup = sustained trajectory subgroup (men > women).

TABLE 5 Comparison of anxiety and depression subgroups.

Anxiety subgroup	Depression subgroup			
	Low	**High**	**Sustained**	**Total**
Low	637 (87%)	89 (12%)	5 (<1%)	731
High	54 (25%)	132 (60%)	33 (15%)	219
Sustained	5 (10%)	19 (37%)	27 (53%)	51
Total	696	240	65	1001

Note: Percentages reflect proportions in each depression subgroup based on the anxiety subgroups.

health or substance use disorders, or lower PTSD symptoms. For example, older adults have higher rates of 30-day and past-year abstinence than younger adults (Satre et al., 2004) and people with depression and alcohol problems have lower rates of treatment success and increased rates of depression relapse than people with only depression (Sullivan et al., 2005). However, the low subgroup did not merely reflect a lack of a co-occurring anxiety or depressive disorder; in the low subgroups, 22% had a cooccurring anxiety disorder and 29% had a co-occurring depressive disorder. Therefore, intake diagnoses may not be a reliable predictor of the ultimate trajectory. Instead, initial anxiety and depression scores were the strongest predictors, which argues for including dimensional measures of anxiety and depression at treatment intake.

These results also highlight an essential sex difference for the depression trajectories: women were more likely to be in the high trajectory relative to the low trajectory subgroup. This finding is consistent with previous studies that showed higher levels of depression in women with AUD as compared to men (Oliva et al., 2018; Petit et al., 2017). In contrast to previous studies, our study included more frequent assessments of depression during the early abstinence phase and women in community treatment. Of note, the previous SUD subtype studies did not find sex differences, which might be due to their inclusion of people with any SUD, not just a primary AUD (Drossel et al., 2023; Robinson et al., 2024). Our study results suggest that women may experience more severe depressive symptoms in early abstinence compared to men. This is important because high levels of depression increase the risk of relapse, and the relationship between depression and relapse may be even more pronounced among women (Abulseoud et al., 2013). Thus, women with AUD may benefit from regular assessment of depression during

early abstinence and interventions that focus on both depression and relapse prevention.

The trajectory analysis identified two smaller subgroups that were characterized by high initial anxiety and depression scores, which were significantly above the clinical cutoffs for those scales. The smaller proportion of individuals in the subgroups characterized by high negative affect is consistent with previous latent factor analyses (Drossel et al., 2023; Robinson et al., 2024). Our dense sample approach highlighted the time course of weekly symptoms. The high trajectory subgroups had high initial scores that declined rapidly over the first 2 weeks, with mild symptoms persisting across treatment and remaining higher than those in the low trajectory group. In contrast, the sustained trajectory subgroup had a much slower symptom decline. Notably, for the sustained trajectory anxiety subgroup, anxiety scores remained above the clinical cut-off at the end of treatment. The higher levels of sustained anxiety scores, relative to depression scores, are consistent with findings from Driessen et al. (2001).

The logistic regression analysis revealed key predictors of differences between the high trajectory and sustained trajectory groups. For the anxiety subgroups, higher initial anxiety symptoms and PTSD symptoms predicted assignment to the sustained trajectory versus high trajectory groups. For the depression subgroups, higher initial depression symptoms and PTSD symptoms predicted assignment to the sustained trajectory versus high trajectory groups. Thus, for both the anxiety and depression subgroups, initial symptom scores were more powerful predictors than co-occurring disorders. These results suggest a benefit to including brief dimensional measures of anxiety and depression at treatment intake. However, it should be noted that the area under the curve values were only moderate for both the anxiety and depression logistic regression analyses, suggesting that variables included in this study are not sufficiently predictive for determining who will have sustained anxiety or depression symptoms. Thus, other variables should be considered in future studies. These findings also argue for including weekly measures of anxiety and depression symptoms to best distinguish between trajectory subgroups.

Across all analyses, PTSD symptom scores at intake emerged as a key distinguishing variable for both the anxiety and depression analyses. PTSD scores were the only predictor, besides initial anxiety or trajectory depression scores, that significantly differentiated between the high trajectory and sustained groups. Notably, the contribution of PTSD scores was not captured by having co-occurring PTSD. The link between PTSD symptoms and depression trajectories is not surprising, given the overlap between diagnostic criteria. A parsimonious explanation is that PTSD scores were highly correlated with initial anxiety and depression scores. While initial anxiety and depression scores were associated with PTSD scores ($r = 0.47$ and $r = 0.44$, respectively), the fact that both anxiety and depression symptoms and PTSD scores emerged as unique predictors suggests that PTSD scores made a unique contribution above and beyond anxiety or depression symptoms. AUD and PTSD are highly cooccurring, and AUD may either precede or follow trauma (Smith & Cottler, 2018). Thus, the association between PTSD scores and both anxiety and depression trajectories may reflect the impact of chronic drinking on the dysregulation of stress neurobiology or the effect of trauma on neurobiological or other factors related to alcohol consumption, anxiety, depression, or maladaptive coping strategies (Sinha, 2022). In addition, PTSD symptoms and alcohol use have a bidirectional relationship that may impact successful AUD treatment (Tripp et al., 2020). Thus, the inclusion of a dimensional measure of PTSD symptoms at treatment intake may have clinical utility.

The trajectory of anxiety or depression symptom scores is likely to have clinical relevance. People in early abstinence with high anxiety or depression are at an increased risk for relapse and other adverse clinical outcomes (Sinha, 2011; Witkiewitz & Villarroel, 2009). Emerging evidence also suggests that sustained anxiety or depression may predict treatment response. Thus, people who have sustained anxiety or depression during early abstinence, such as our sustained trajectory subgroup, may be prime candidates for more intensive treatment approaches, including more frequent monitoring, anti-brown anxiety medication, and anxiety-focused psychotherapy (Mariani & Levin, 2004). Early identification of heightened negative affect among individuals with AUD may allow for timelier access to interventions that target anxiety or depression, which could improve treatment engagement and retention among this high-risk subgroup.

This study had several limitations. First, anxiety and depression were measured using brief scales, which are clinically useful but may not capture the full complexity of these disorders and could overlook specific aspects, such as social anxiety or anhedonia. Second, while the sample was large, it lacked racial and ethnic diversity, had a higher proportion of men, and the self-report of gender was binary, which could limit statistical power to detect differences by race, ethnicity, or gender identity and may limit generalizability. Third, the electronic health record data did not include the length of abstinence before entering treatment. However, the pattern of symptom scores observed for the full sample, with heightened anxiety and depression that diminished within the first 2 weeks, is consistent with multiple previous reports that investigated anxiety and depression in research-based treatment studies where the length of abstinence was measured. In those studies, the average lengths of abstinence were as follows: 26.5 h (Liappas et al., 2002), 9.35 days (Brown et al., 1991; Brown & Schuckit, 1988), and 21 days (Voltaire-Carlsson et al., 1996). Fourth, the psychiatric diagnoses were obtained during a standard clinical intake process and not a structured research interview. While this provided real-world information from the electronic medical record, there were several potential limitations, including the potential for differences between clinicians and a lack of information on lifetime diagnoses. Fifth, while all people in the treatment program were receiving intensive treatments—which could include individual therapy, group therapy, and/or medications for AUD—detailed data on treatments were not available from the deidentified dataset. Therefore, there is a possibility that differences in subgroup trajectories were associated with differences in treatment not captured in this study. Sixth, the deidentified electronic medical record data only included limited information on demographic characteristics; therefore, we were unable to examine other potentially important characteristics, such as socioeconomic status, employment status, or social support. Lastly,

while anxiety and depression symptoms have been shown to predict relapse risk (Driessen et al., 2001), we did not have relapse data in this study; therefore, it is unknown whether the sustained subgroup was at higher risk for relapse. It will be critical for future studies to assess relapse subgroups to determine the potential long-term implications.

In conclusion, our study identified multiple distinct patterns of anxiety and depression symptoms during early abstinence from AUD. Among the strengths of this study are the large sample of people in the community substance use treatment program, dense sampling measurement, and latent growth curve models. Using these methods, we found that characterizing the time course of negative affect symptoms provides unique information above and beyond cooccurring diagnoses. Identifying these subgroups has important clinical implications; individuals with sustained symptoms may require more intensive and tailored interventions. Overall, our results highlight the need for a personalized approach in the treatment of AUD, focusing on early detection and management of negative affect to enhance treatment outcomes and support long-term recovery.

ACKNOWLEDGMENTS

This study was supported by the National Institutes of Health: NIDA T32DA007294 (MG), NIAAA F30AA027418 (EAF), NIAAA R01AA029127 (JUB), and NIAAA P60AA031124 (JUB).

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The results from the statistical analyses that support the findings of this study are available from the corresponding author upon reasonable request. The individual-level data were provided by Cumberland Heights Foundation through a limited Data Use Agreement. Data are available from the author(s) with the written permission of Cumberland Heights Foundation.

ORCID

Manesh Gopaldas https://orcid.org/0000-0001-9304-5096
Jennifer Urbano Blackford https://orcid.org/0000-0002-0261-4845

REFERENCES

Abulseoud, O.A., Karpyak, V.M., Schneekloth, T., Hall-Flavin, D.K., Loukianova, L.L., Geske, J.R. et al. (2013) A retrospective study of gender differences in depressive symptoms and risk of relapse in patients with alcohol dependence. *The American Journal on Addictions*, 22, 437–442. Available from: https://doi.org/10.1111/j.1521-0391.2013.12021.x

Blevins, C.A., Weathers, F.W., Davis, M.T., Witte, T.K. & Domino, J.L. (2015) The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation: posttraumatic stress disorder checklist for DSM-5. *Journal of Traumatic Stress*, 28, 489–498. Available from: https://doi.org/10.1002/jts.22059

Brown, S.A., Irwin, M. & Schuckit, M.A. (1991) Changes in anxiety among abstinent male alcoholics. *Journal of Studies on Alcohol*, 52, 55–61. Available from: https://doi.org/10.15288/jsa.1991.52.55

Brown, S.A. & Schuckit, M.A. (1988) Changes in depression among abstinent alcoholics. *Journal of Studies on Alcohol*, 49, 412–417. Available from: https://doi.org/10.15288/jsa.1988.49.412

Carroll, K.M. (2021) The profound heterogeneity of substance use disorders: implications for treatment development. *Current Directions in Psychological Science*, 30, 358–364. Available from: https://doi.org/10.1177/09637214211026984

Davidson, M., Shanley, B. & Wilce, P. (1995) Increased NMDA-induced excitability during ethanol withdrawal: a behavioural and histological study. *Brain Research*, 674, 91–96. Available from: https://doi.org/10.1016/0006-8993(94)01440-s

Driessen, M., Meier, S., Hill, A., Wetterling, T., Lange, W. & Junghanns, K. (2001) The course of anxiety, depression and drinking behaviours after completed detoxification in alcoholics with and without comorbid anxiety and depressive disorders. *Alcohol and Alcoholism*, 36, 249–255. Available from: https://doi.org/10.1093/alcalc/36.3.249

Drossel, G., Brucar, L.R., Rawls, E., Hendrickson, T.J. & Zilverstand, A. (2023) Subtypes in addiction and their neurobehavioral profiles across three functional domains. *Translational Psychiatry*, 13, 127. Available from: https://doi.org/10.1038/s41398-023-02426-1

Durazzo, T.C. & Meyerhoff, D.J. (2017) Psychiatric, demographic, and brain morphological predictors of relapse after treatment for an alcohol use disorder. *Alcoholism, Clinical and Experimental Research*, 41, 107–116. Available from: https://doi.org/10.1111/acer.13267

Gallagher, C., Radmall, Z., O'Gara, C. & Burke, T. (2018) Anxiety and depression among patients with alcohol dependence: co-morbid or substance-related problems? *Irish Journal of Psychological Medicine*, 35, 121–126. Available from: https://doi.org/10.1017/ipm.2017.25

Griswold, M.G., Fullman, N., Hawley, C., Arian, N., Zimsen, S.R.M., Tymeson, H.D. et al. (2018) Alcohol use and burden for 195 countries and territories, 1990–2016: a systematic analysis for the global burden of disease study 2016. *The Lancet*, 392, 1015–1035. Available from: https://doi.org/10.1016/S0140-6736(18)31310-2

Heilig, M., Egli, M., Crabbe, J.C. & Becker, H.C. (2010) Acute withdrawal, protracted abstinence and negative affect in alcoholism: are they linked? *Addiction Biology*, 15, 169–184. Available from: https://doi.org/10.1111/j.1369-1600.2009.00194.x

Kirshenbaum, A.P., Olsen, D.M. & Bickel, W.K. (2009) A quantitative review of the ubiquitous relapse curve. *Journal of Substance Abuse Treatment*, 36, 8–17. Available from: https://doi.org/10.1016/j.jsat.2008.04.001

Koob, G.F. (2022) Anhedonia, hyperkatifeia, and negative reinforcement in substance use disorders. *Current Topics in Behavioral Neurosciences*, 58, 147–165. Available from: https://doi.org/10.1007/7854_2021_288

Koob, G.F. & Mason, B.J. (2016) Existing and future drugs for the treatment of the dark side of addiction. *Annual Review of Pharmacology and Toxicology*, 56, 299–322. Available from: https://doi.org/10.1146/annurev-pharmtox-010715-103143

Kroenke, K., Spitzer, R.L. & Williams, J.B. (2001) The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16, 606–613. Available from: https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Kwako, L.E., Momenan, R., Litten, R.Z., Koob, G.F. & Goldman, D. (2016) Addictions neuroclinical assessment: a neuroscience-based framework for addictive disorders. *Biological Psychiatry*, 80, 179–189. Available from: https://doi.org/10.1016/j.biopsych.2015.10.024

Liappas, J., Paparrigopoulos, T., Tzavellas, E. & Christodoulou, G. (2002) Impact of alcohol detoxification on anxiety and depressive symptoms. *Drug and Alcohol Dependence*, 68, 215–220. Available from: https://doi.org/10.1016/S0376-8716(02)00195-3

Ludenia, K., Donham, G.W., Holzer, P.D. & Sands, M.M. (1984) Anxiety in an alcoholic population: a normative study. *Journal of Clinical Psychology*, 40, 356–358. Available from: https://doi.org/10.1002/1097-4679(198401)40:1<356::AID-JCLP2270400166>3.0.CO;2-P

Maisto, S.A., Clifford, P.R., Stout, R.L. & Davis, C.M. (2006) Drinking in the year after treatment as a predictor of three-year drinking outcomes. *Journal of Studies on Alcohol*, 67, 823–832. Available from: https://doi.org/10.15288/jsa.2006.67.823

Mariani, J.J. & Levin, F.R. (2004) Pharmacotherapy for alcohol-related disorders: what clinicians should know. *Harvard Review of Psychiatry*, 12, 351–366. Available from: https://doi.org/10.1080/10673220490905697

Oliva, F., Nibbio, G., Vizzuso, P., Jaretti Sodano, A., Ostacoli, L., Carletto, S. et al. (2018) Gender differences in anxiety and depression before and after alcohol detoxification: anxiety and depression as gender-related predictors of relapse. *European Addiction Research*, 24, 163–172. Available from: https://doi.org/10.1159/000490046

Ottonello, M., Fiabane, E., Pistarini, C., Spigno, P. & Torselli, E. (2019) Difficulties in emotion regulation during rehabilitation for alcohol addiction: correlations with metacognitive beliefs about alcohol use and relapse risk. *Neuropsychiatric Disease and Treatment*, 15, 2917–2925. Available from: https://doi.org/10.2147/NDT.S214268

Petit, G., Deschietere, G., Loas, G., Luminet, O. & de Timary, P. (2020) Link between anhedonia and depression during early alcohol abstinence: gender matters. *Alcohol and Alcoholism*, 55, 71–77. Available from: https://doi.org/10.1093/alcalc/agz090

Petit, G., Luminet, O., de Cordovil Sousa Uva, M., Monhonval, P., Leclercq, S., Spilliaert, Q. et al. (2017) Gender differences in affects and craving in alcohol-dependence: a study during alcohol detoxification. *Alcoholism, Clinical and Experimental Research*, 41, 421–431. Available from: https://doi.org/10.1111/acer.13292

Proust-Lima, C., Philipps, V. & Liquet, B. (2017) Estimation of extended mixed models using latent classes and latent processes: the R package lcmm. *Journal of Statistical Software*, 78, 1–56. Available from: https://doi.org/10.18637/jss.v078.i02

R Core Team. (2024) *R: a language and environment for statistical computing*. Vienna: R Foundation for Statistical Computing.

Roberts, M.C., Emsley, R.A., Pienaar, W.P. & Stein, D.J. (1999) Anxiety disorders among abstinent alcohol-dependent patients. *Psychiatric Services*, 50, 1359–1361. Available from: https://doi.org/10.1176/ps.50.10.1359

Robinson, L.D., Degan, T.J., Deane, F.P. & Kelly, P.J. (2024) Patterns of substance use recovery following residential treatment: a repeated measures latent profile analysis. *Drug and Alcohol Review*, 43, 1985–1996. Available from: https://doi.org/10.1111/dar.13904

Satre, D.D., Mertens, J.R., Areán, P.A. & Weisner, C. (2004) Five-year alcohol and drug treatment outcomes of older adults versus middle-aged and younger adults in a managed care program. *Addiction*, 99, 1286–1297. Available from: https://doi.org/10.1111/j.1360-0443.2004.00831.x

Schmid, F., Benzerouk, F., Barrière, S., Henry, A., Limosin, F., Kaladjian, A. et al. (2021) Heterogeneity of executive function abilities in recently detoxified patients with alcohol use disorder: evidence from a cluster analysis. *Alcoholism: Clinical and Experimental Research*, 45, 163–173. Available from: https://doi.org/10.1111/acer.14517

Sinha, R. (2011) New findings on biological factors predicting addiction relapse vulnerability. *Current Psychiatry Reports*, 13, 398–405. Available from: https://doi.org/10.1007/s11920-011-0224-0

Sinha, R. (2022) Alcohol's negative emotional side: the role of stress neurobiology in alcohol use disorder. *Alcohol Research: Current Reviews*, 42, 12. Available from: https://doi.org/10.35946/arcr.v42.1.12

Smith, N.D.L. & Cottler, L.B. (2018) The epidemiology of post-traumatic stress disorder and alcohol use disorder. *Alcohol Research: Current Reviews*, 39, 113–120.

Spitzer, R.L., Kroenke, K., Williams, J.B.W. & Löwe, B. (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine*, 166, 1092. Available from: https://doi.org/10.1001/archinte.166.10.1092

Substance Abuse and Mental Health Services Administration. (2022) *Key substance use and mental health indicators in the United States: results from the 2021 National Survey on Drug Use and Health (HHS publication no. PEP22-07-01-005, NSDUH series H-57) (no. HHS publication no. PEP22-07-01-005, NSDUH series H-57)*. Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration.

Sullivan, E.V. (2020) Why timing matters in alcohol use disorder recovery. *American Journal of Psychiatry*, 177, 1022–1024. Available from: https://doi.org/10.1176/appi.ajp.2020.20091323

Sullivan, L.E., Fiellin, D.A. & O'Connor, P.G. (2005) The prevalence and impact of alcohol problems in major depression: a systematic review. *The American Journal of Medicine*, 118, 330–341. Available from: https://doi.org/10.1016/j.amjmed.2005.01.007

Tripp, J.C., Worley, M.J., Straus, E., Angkaw, A.C., Trim, R.S. & Norman, S.B. (2020) Bidirectional relationship of posttraumatic stress disorder (PTSD) symptom severity and alcohol use over the course of integrated treatment. *Psychology of Addictive Behaviors*, 34, 506–511. Available from: https://doi.org/10.1037/adb0000564

Volkow, N.D., Wang, G.-J., Telang, F., Fowler, J.S., Logan, J., Jayne, M. et al. (2007) Profound decreases in dopamine release in striatum in detoxified alcoholics: possible orbitofrontal involvement. *The Journal of Neuroscience*, 27, 12700–12706. Available from: https://doi.org/10.1523/JNEUROSCI.3371-07.2007

Voltaire-Carlsson, A., Hiltunen, A.J., Koechling, U.M. & Borg, S. (1996) Effects of long-term abstinence on psychological functioning: a prospective longitudinal analysis comparing alcohol-dependent patients and healthy volunteers. *Alcohol*, 13, 415–421. Available from: https://doi.org/10.1016/0741-8329(96)81678-8

White, A.M., Castle, I.-J.P., Powell, P.A., Hingson, R.W. & Koob, G.F. (2022) Alcohol-related deaths during the covid-19 pandemic. *JAMA*, 327, 1704–1706. Available from: https://doi.org/10.1001/jama.2022.4308

Witkiewitz, K., Litten, R.Z. & Leggio, L. (2019) Advances in the science and treatment of alcohol use disorder. *Science Advances*, 5, eaax4043. Available from: https://doi.org/10.1126/sciadv.aax4043

Witkiewitz, K. & Villarroel, N.A. (2009) Dynamic association between negative affect and alcohol lapses following alcohol treatment. *Journal of Consulting and Clinical Psychology*, 77, 633–644. Available from: https://doi.org/10.1037/a0015647

Zhao, J., Linn, B., Bradizza, C., Lucke, J., Ruszczyk, M. & Stasiewicz, P. (2021) Heterogeneity in DSM-5 symptom criteria: phenotypes of alcohol use disorder in a sample seeking alcohol treatment. *Alcohol and Alcoholism*, 56, 660–668. Available from: https://doi.org/10.1093/alcalc/agaa138

Zywiak, W.H., Connors, G.J., Maisto, S.A. & Westerberg, V.S. (1996) Relapse research and the reasons for drinking questionnaire: a factor analysis of Marlatt's relapse taxonomy. *Addiction*, 91(Suppl), S121–S130.

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How to cite this article: Gopaldas, M., Flook, E.A., Hayes, N., Benningfield, M.M. & Blackford, J.U. (2025) Subgroups of anxiety and depression trajectories during early abstinence in alcohol use disorder. *Alcohol: Clinical and Experimental Research*, 49, 1086–1096. Available from: https://doi.org/10.1111/acer.70032