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Article type : Original Research Article

Title: Depression, Alcoholics Anonymous Involvement, and Daily Drinking Among Patients with Co-occurring Conditions: A Longitudinal Parallel Growth Mixture Model

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/ACER.14474](https://doi.org/10.1111/ACER.14474)

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50 Acknowledgements and funding:

51 Noel Vest was supported by the National Institute on Drug Abuse of the National Institutes of
52 Health under Award Number T32DA035165. In addition, this research was supported by an
53 Investigator Initiated Research project (IAC 09-055 to Dr. Timko and Dr. Ilgen as Multiple
54 Principal Investigators), Senior Research Career Scientist Awards (RCS 00-001 to Dr. Timko;
55 RCS 14-141 to Dr. Humphreys), and Research Career Scientist Awards (RCS 14-232 to Dr.
56 Harris and RCS 19-333 to Dr. Ilgen) by the Department of Veterans Affairs (VA) Health

57 Services Research and Development (HSR&D) Service. The views expressed are the authors'
58 and do not necessarily reflect the official position of any government agency.

59 ABSTRACT

60 **Background:** Patients with co-occurring mental health and substance use disorders often find it
61 difficult to sustain long-term recovery. One predictor of recovery may be how depression
62 symptoms and Alcoholics Anonymous (AA) involvement influence alcohol consumption during
63 and after inpatient psychiatric treatment. This study utilized a parallel growth mixture model to
64 characterize the course of alcohol use, depression, and AA involvement in patients with co-
65 occurring diagnoses.

66 **Methods:** Participants were adults with co-occurring disorders (n = 406) receiving inpatient
67 psychiatric care as part of a telephone monitoring clinical trial. Participants were assessed at
68 intake, 3, 9, and 15-month follow-up.

69 **Results:** A 3-class solution was the most parsimonious based upon fit indices and clinical
70 relevance of the classes. The classes identified were high AA involvement with normative
71 depression (27%), high stable depression with uneven AA involvement (11%), and low AA
72 involvement with normative depression (62%). Both the low and high AA classes reduced their
73 drinking across time and were drinking at less than half their baseline levels at all follow-ups.
74 The high stable depression class reported an uneven pattern of AA involvement and drank at
75 higher daily frequencies across the study timeline. Depression symptoms and alcohol use
76 decreased substantially from intake to 3 months and then stabilized for 90% of patients with co-
77 occurring disorders following inpatient psychiatric treatment.

78 **Conclusions:** These findings can inform future clinical interventions among patients with co-
79 occurring mental health and substance use disorders. Specifically, patients with more severe
80 symptoms of depression may benefit from increased AA involvement, whereas patients with less
81 severe symptoms of depression may not.

82

83 **Keywords:** longitudinal growth mixture model; depression; Alcoholics Anonymous involvement;
84 alcohol use; co-occurring patients

85

86 Introduction

87 Over 9 million Americans have co-occurring substance use and mental health disorders
88 (Substance Abuse and Mental Health Services Administration, 2019) with some 58% of
89 individuals receiving psychiatric inpatient services also reporting a lifetime diagnosis of
90 substance use disorder (Mueser et al., 2000). Population surveys show that about one-half of
91 people who experience a mental health disorder such as major depressive disorder during their
92 lifetime will also experience a substance use disorder (National Institute on Drug Abuse, 2020).
93 When individuals seek care for either condition, they can be clinically challenging, incur high
94 health care costs, and have longer lengths of stay and higher relapse rates than those with only
95 one of these conditions (Chen, Barnett, Sempel, & Timko, 2006; Drake, Mueser, Clark, &
96 Wallach, 1996; Jané-Llopis & Matytsina, 2006; Kranzler & Rosenthal, 2003; Stöffelmayr,
97 Benishek, Humphreys, Lee, & Mavis, 1989). To inform care of this vulnerable clinical
98 population, this study aimed to understand the unique change processes that influence longer-
99 term outcomes among these patients after inpatient psychiatric care, including their involvement
100 in peer mutual-help groups.

101 Mutual-help groups often serve as a source of primary recovery support and as an adjunct
102 to treatment for patients with co-occurring conditions (Humphreys, 2003; Tonigan et al., 2018),
103 with the hope that these individuals will maintain their involvement after treatment. Research
104 suggests that people with co-occurring conditions benefit from mutual-help groups such as
105 Alcoholics Anonymous (AA), Double Trouble, and Narcotics Anonymous, (Bogenschutz et al.,
106 2006; Magura, 2008; Timko et al., 2013; Tonigan et al., 2018). Prospective research has shown
107 that AA involvement (i.e., engagement in 12-step practices such as reading literature, having a
108 sponsor, and service work) predicts declines in depression symptoms over time (Humphreys et
109 al., 1997). Studies are needed to examine the influence of group involvement across time, and
110 document patterns of response within the heterogeneous population.

111 Major depressive disorder (MDD) merits special attention in discussions of co-occurring
112 disorders because it is the most prevalent mental health disorder among individuals treated for
113 substance use disorders (Hides et al., 2019; Hobden et al., 2018; Torrens et al., 2011) and has
114 been associated with shorter time to relapse after treatment (Suter, Strik, & Möggi, 2011).
115 Depression symptoms also tend to decrease, on average, over time among individuals in
116 substance use treatment (Overall, Reilly, Kelley, & Hollister, 1985), including those in
117 psychiatric inpatient care (Foulds et al., 2015). For example, in a study of 1706 substance use

118 disorder outpatients, depression symptom levels decreased from intake to 3 months and then
119 were stable over the next year (Kelly et al., 2010b). Further, greater AA attendance was
120 associated with less alcohol use and lower levels of depression. However, when alcohol use was
121 controlled, the effect of AA participation on depression was muted, suggesting that reductions in
122 drinking accounted for the relationship between AA participation and reduced depression (Kelly
123 et al., 2010b). Additionally, in a study examining inpatients with SUD, with and without co-
124 occurring MDD, Kelly et al. (2003) found that substance use outcomes did not differ between the
125 groups at 1 and 2 years post-treatment. However, in a moderation analysis, the co-occurring
126 group's probability of remission and abstinence outcomes worsened as a function of their level
127 of 12-step mutual-help involvement at 2 years post-treatment.. These findings in inpatients and
128 outpatients treated for SUD begin to paint a picture of what may be happening to these patients
129 post-treatment, but more research is needed to determine *when* these reductions in depression
130 symptomatology and AA involvement may occur across time, whether these effects hold among
131 those treated in inpatient psychiatric settings, and further, how changes in depression and AA
132 involvement may influence daily alcohol use among those with a co-occurring condition.

133 Previous examinations of depression, AA involvement, and alcohol use have employed a
134 variable based approach that focuses on a priori categorization of these constructs. This approach
135 includes estimating regression models in which alcohol use is modeled across time as a function
136 of levels of depression or AA involvement. Though this approach may be informative for
137 understanding each of these processes individually, a person-based approach (Nagin and Odgers,
138 2010), used in the present study, allows description of the shape of alcohol use trajectories and
139 the influence of depression and AA involvement that are observed in the population across time.
140 Lastly, data-derived latent classes¹ can be used to examine demographic and other important
141 clinical characteristics that may vary across classes.

142 This study used such an approach to examine the relationship among alcohol use,
143 symptoms of depression, and AA involvement by applying a person-centered modeling
144 technique to relate long-term trajectories. It also used the classes to examine differences on
145 demographic characteristics and other important indicators that may differ by class membership.

¹ Throughout out this paper we refer to the analytic approach as a longitudinal parallel growth mixture model, or simply, growth mixture model. Importantly, this statistical approach is a type of latent class analysis with repeated measures. Hence, results are discussed in terms of latent classes or data-derived patient subgroups.

146 These included prior treatment, incarceration history, and amount spent on alcohol, which prior
147 studies have shown are associated with outcomes among patients treated for co-occurring
148 disorders (Najt et al., 2011; Painter et al., 2018; Watkins et al., 2016).

149 Accordingly, this study examined AA participation patterns, depression symptoms, and
150 alcohol consumption among latent classes of patients with co-occurring mental health and
151 substance use disorders who had been admitted to veteran psychiatric inpatient care. Specifically,
152 we used parallel growth mixture modeling to simultaneously assess levels of depression
153 symptoms, AA involvement, and daily alcohol use trajectories during and after inpatient
154 psychiatric treatment. The aim was to inform treatment planning for patients hospitalized for co-
155 occurring conditions by observing the course of drinking and depression symptoms over time in
156 relation to AA involvement, including the proportion of patients who may need more intensive
157 treatment resources after hospital discharge, and how long after discharge the need for such
158 treatment may occur due to an increase in drinking and/or depression symptoms. The findings
159 may also suggest the extent to which providers should refer patients to AA or to other post-
160 treatment recovery resources to achieve benefits on alcohol use and depression symptoms.

161 Materials and methods

162 This was a secondary analysis of data from a randomized controlled trial that compared
163 usual care with telephone monitoring on the primary outcomes of alcohol and other drug use and
164 mental health symptoms among patients at two health care facilities within the Veterans Health
165 Administration (VA) health care system (Timko et al., 2019). The inpatient psychiatry treatment
166 averaged 7 days and interventions included comprehensive assessment, psychopharmacology,
167 individual and group psychotherapy, and behavioral interventions. Patients in both conditions
168 improved over time on each primary outcome, and improvement was comparable between
169 conditions (Timko et al., 2019).

170 *Participants and Study Design*

171 The original study included 406 patients with a co-occurring diagnosis of substance use
172 and mental health disorders as documented in the medical record. Participants completed a self-
173 report measure at baseline and then at 3-month, 9-month, and 15-month follow-ups. Participants
174 received \$25 for each completed assessment. Because the telephone monitoring intervention did
175 not have a significant effect on any relevant outcomes, we collapsed the treatment and control
176 groups across conditions. At baseline, the mean age was 44.9 (SD = 12.9), 29.6% were married,

177 and 7.2% of participants were currently homeless. The sample was primarily male (90.0%) and
178 Caucasian (63.1%).

179 *Measures*

180 The Addiction Severity Index (ASI; McLellan, Cacciola, Alterman, Rikoon, & Carise,
181 2006) was used to assess participants' baseline demographic and other characteristics that are
182 listed in Table 3. In addition, at baseline and each follow-up, the Time Line Follow Back
183 procedure (Sobell et al., 1996), a widely-used, standardized, calendar-based retrospective self-
184 report assessment to quantify daily substance use, assessed the number days the participant used
185 alcohol in the past 90 days. AA Involvement was also assessed at baseline and each follow-up,
186 and was the count of 14 12-step practices the participant reported having engaged in, such as
187 reading 12-step literature, serving at meetings, and having a sponsor (Timko et al., 2017).
188 Cronbach's alpha for the AA involvement scale at baseline, 3 months, 9 months, and 15 months
189 was .87, .90, .91, and .92, respectively. Depression symptoms were assessed with the Patient
190 Health Questionnaire (PHQ-9), which has excellent internal consistency and test-retest reliability
191 and contains nine items, each scored 0 to 3, providing a 0 to 27 severity score (Kroenke et al.,
192 2001). Cronbach's alpha for the PHQ-9 at baseline, 3 months, 9 months, and 15 months was .89,
193 .89, .91, and .94, respectively. Supplement 1 provides a depiction of trajectories for each of the
194 three variables (number of days used alcohol, AA involvement, depression symptoms) across
195 time for each participant in the sample. Additionally, the mean for each measure is shown which
196 illustrates the extreme variability in the model. This heterogeneity offers strong justification for
197 growth mixture modeling of response patterns across the 15-month study period.

198 *Data Analyses*

199 The demographic information class probabilities and analysis of variance (ANOVA)
200 were computed using SPSS ver. 25 (IBM Corporation, 2017). The longitudinal parallel growth
201 mixture model (Nagin, 2005) was analyzed using MPlus version 8.2 (Muthen & Muthen, 2018).
202 Illustrated in Figure 1, this repeated measures growth mixture model utilized simultaneous
203 analysis of parallel outcomes to better understand how depression and AA involvement impact
204 alcohol use after psychiatric inpatient care. The trajectories for depression, AA involvement, and
205 daily alcohol use are summarized by their respective intercepts and slopes. The variances of the
206 intercepts and slopes were set to zero so the means of the growth factors (intercept and slope)
207 were allowed to vary across factors, such that the latent classes were identified by the patterns of

208 alcohol use, depression, and AA involvement change over time. Parallel modeling, rather than
209 separate modeling of these processes, was preferred because the results offer a more efficient and
210 less biased estimate of the effects across time (Olino et al., 2010; Wickrama et al., 2013).

211 Seven patients did not fill out study questionnaires beyond the baseline demographics
212 data, so the final sample included 399 individuals. The follow-up rates for the study were 84%,
213 76%, and 77% at 3, 9, and 15 months respectively. Age was the only demographic characteristic
214 that was significantly different from those who were lost to follow-up and those who were not.
215 Patients who were lost to follow-up were younger than patients not lost to follow-up (3 months:
216 $M=45.6$ ($SD=12.4$) vs. $M=41.9$ ($SD=14.4$), $t=2.22$, $p=.027$; 9 months: 46.0 (12.3) vs. 42.1 (13.7),
217 $t=2.84$, $p=.005$; 15 months: 46.1 (12.4) vs. 41.4 (13.6), $t=3.33$, $p=.001$). Because covariates are
218 not suggested in the latent class enumeration process due to problems with model convergence
219 and overextraction (Nylund-Gibson and Masyn, 2016) we did not control for age in the
220 modeling. However, to assure that age was not confounding the model, we ran the final 3-class
221 model controlling for the influence of age and found that the interpretations of all outcomes were
222 not affected. Missing data were handled with Full Information Maximum Likelihood, robust to
223 data missing at random. This method computes the standard covariance matrix using the entire
224 sample.

225 *Determining patient typology*

226 The ideal number of latent classes is often determined by theoretical considerations
227 regarding clinical relevance and prior research (Nagin & Odgers, 2010; Little, 2013). Typically,
228 the multiclass solutions are compared statistically based upon overall model fit. The Bayesian
229 Information Criterion (BIC) is a common comparison fit statistic used to characterize the number
230 of classes in a dataset (Kass and Raftery, 1995). Along with BIC, we also examined entropy, Lo-
231 Mendell-Rubin (LMR) likelihood ratio test, and overall interpretability of the solutions to
232 determine the most parsimonious and clinically distinct model (Nagin and Odgers, 2010).
233 Entropy is a measure of class membership likelihood that ranges from 0 to 1 (values closer to 1
234 are preferred); values above 0.80 indicate good class membership. The LMR test is a likelihood
235 ratio test that offers a measure of the current mixture model (k) and a sample drawn with ($k-1$)
236 one fewer latent class (Lo et al., 2001). Models were fit for 1 through 6 latent class solutions. For
237 each class solution, we allowed the model to estimate mean values for intercept, slope, quadratic,
238 and cubic functions. We then examined the estimates for each value and reset the non-significant

239 values to zero in a revised model. Because the new values can affect other trajectories in the
240 model, this process was continued until all non-significant values had been set to zero.

241 Lastly, given the latent classes selected for patient typology, overall class inclusion
242 (posterior probability) was then calculated to evaluate differences in frequency of these variables
243 (see Table 3). An ANOVA with Fisher's Least Significant Difference post-hoc test was
244 computed to evaluate class differences.

245 Results

246 Table 1 provides the model fit indices for 1 through 6 latent class solutions. Based on fit
247 indices it was concluded that the 3-class revised solution was the best performing model; AIC =
248 26789, BIC = 26933. BIC values were lower for the 6-class model, but growth trajectories
249 overlapped for many of the 6 classes, and, extremely small class sizes made clinical
250 interpretation impossible. The 3-class model was superior on other fit indices. This final model
251 included 36 parameters, entropy was high at 0.88 (well above the .80 cut-off), the LMR was
252 significant at 540.18, and the estimated classes were of acceptable size (61%, 27%, and 11% of
253 the sample) as well as clinically relevant. As noted in Table 2, average latent class probabilities
254 for inclusion in the individual classes for the 3-class solution were high at 93.7%, 93.8%, and
255 95.4%. That is, for example, the probability that an individual classified as being in Class 1 was
256 classified correctly was 93.7% of the time, on average. Because the entropy was high and the
257 class separation was good, we calculated class differences using the 2-step approach of modal
258 class assignment (Clark and Muthén, 2009).

259 Figure 2 is a graphical presentation of the three classes over time. The following classes
260 are defined by the most parsimonious 3-class model: (1) high AA involvement (normative
261 depression), (2) high stable depression (uneven AA involvement), and (3) low AA involvement
262 (normative depression) class. Class 1 (high AA involvement), represents a class with high and
263 consistent AA involvement, normative (defined as an initial decrease followed by a leveling off
264 across time) alcohol use, and a normative depression (defined as an initial decrease in depression
265 from baseline to 30 days followed by a leveling off across time) trajectory (blue lines in Figure
266 2; n = 109, 27.3%). Class 2 (high depression) was characterized by high stable depression, low
267 AA involvement, and high alcohol use (orange lines in Figure 2; n = 42, 10.5%). Class 3 (low
268 AA involvement) represents a low AA involvement, typical depression, and typical alcohol use
269 class (grey lines in Figure 2; n = 248, 62.2%). Two of the classes (high AA and low AA) each

270 demonstrated similar trajectories for depression and alcohol use, yet differed from each other in
271 their AA involvement. Both of the AA classes decreased their daily drinking levels substantially
272 by the end of the 15-month follow-up. In contrast, the high depression class appeared to be the
273 most unstable regarding AA involvement across the study period, with no decrease in depression
274 and a high, yet stable, level of drinking.

275 Table 3 shows the most likely class membership (posterior probabilities) for key
276 demographic variables and other outcomes of interest among the sample. Using ANOVA
277 statistical tests, when compared to the low AA class, the high AA class had significantly more
278 previous outpatient treatment episodes and more months of incarceration. The high depression
279 class reported that they continued drinking though it worsened mental or physical health
280 problems when compared to the low and high AA classes (which did not differ significantly
281 from each other). The high depression class also reported more money spent on alcohol in the
282 past 30 days than the low AA class.

283 Discussion

284 To our knowledge, this is the first study to examine the parallel change trajectories of AA
285 involvement, depression, and alcohol use among patients with co-occurring conditions. These
286 findings contribute to the literature on AA involvement among individuals with co-occurring
287 disorders. Previous work has evaluated the influence of AA involvement on drinking outcomes,
288 but this is the first to empirically classify individuals into patient classes based on outcome
289 trajectories. The results highlight multiple paths to recovery, some involving AA and some not.
290 This is encouraging in that many patients in this diverse population showed significant
291 improvement on drinking while they utilized different strategies or approaches to recovery.

292 Almost 90% of the sample had cut their alcohol use by 50% or more by the end of the 15-
293 month study. From a public health perspective, this constitutes a positive outcome among this
294 patient group. Recent empirical reviews indicate that, even among those patients with established
295 alcohol use disorders, significant reductions in alcohol use without achieving full abstinence
296 were associated with improved long term functional outcomes (Mann et al., 2017; Witkiewitz
297 and Tucker, 2019). This is also consistent with epidemiological work suggesting that among
298 individuals in remission from alcohol use disorder, the majority (61%) were not abstinent in a 3-
299 year follow-up (Dawson et al., 2007). Across the same 15-month period, patients with co-
300 occurring conditions in the current study also reported substantially reduced depression symptom

301 levels. This also suggests that many individuals with co-occurring psychiatric and substance use
302 disorders who are seen in inpatient psychiatric treatment settings report overall improvements in
303 the primary disease outcomes (depression and alcohol consumption) following their inpatient
304 stay.

305 There were several unique features of the class with high AA involvement. These
306 individuals reported a mean of 5 previous outpatient treatment episodes, with the other classes
307 only reporting 2 and 1 previous treatment episodes on average (Table 3). This suggests that those
308 with multiple treatment episodes are more likely to become increasingly involved in AA over
309 time. These findings are consistent with previous work showing the positive relationship
310 between baseline SUD severity and subsequent AA involvement (Bogenschutz, 2008), though
311 the presence of a co-occurring mental health issue (Bergman et al., 2014) or more severe
312 conditions (Timko et al., 2013) have been shown to possibly hinder mutual-help involvement.
313 Such findings may offer insight as to why this study found lower levels of AA involvement
314 among the high depression class. The high AA involvement class also reported long lengths of
315 lifetime incarcerations with an overall average of 20 months, compared with 14 and 9 months in
316 the other classes. Although future research is needed to investigate other variables that may be
317 influencing findings for incarceration and treatment, results suggest that these institutions should
318 continue to supplement clinical interventions with adjunctive AA meetings to facilitate AA
319 involvement.

320 All three classes had comparable, high levels of baseline depression levels but differed in
321 the stability of depression across time. The high and low AA involvement classes had a similar
322 trajectory of a rapid decrease in depression scores from 0 to 3 months and then a leveling off
323 from 3 to 15 months. This suggests that patients in these classes may have symptoms of
324 depression which are substance-induced (Dakwar et al., 2011) and more transitory in nature.
325 Individuals in the high depression class had inconsistent AA involvement and reported continued
326 drinking overtime. These individuals may need an intervention to either increase AA
327 involvement or find alternatives to AA to help reduce their alcohol use. A follow-up
328 questionnaire inquiring about the reasons for refusal of AA involvement (Kelly et al., 2010a)
329 would help to inform clinicians on potential barriers for this patient group. Importantly, the high
330 depression class spent a mean of \$267 (15.6% of total income) on alcohol in the month prior to
331 entering treatment and 93% reported that they had continued to drink alcohol despite it causing

332 mental or physical health problems. These findings suggest that amount spent on alcohol, and
333 alcohol use despite negative health outcomes, may offer latent measures of clinical severity for
334 individuals with co-occurring conditions.

335 This study has limitations. First, time-variant indicators other than depression, AA
336 involvement, and daily alcohol use variables could be important for characterizing the population
337 of patients with co-occurring disorders. For example, PTSD and AA attendance (as opposed to
338 AA involvement) offer two important outcomes among this patient population that we were not
339 able to capture with this study. Second, among clinical populations depression is most often
340 diagnosed through structured interview. However, this study design implemented a self-report
341 survey to measure depression symptomatology across time. This limitation is noteworthy and
342 future research will be needed to examine the effects of AA involvement on individuals meeting
343 diagnostic criteria for MDD. Third, the external validity of these findings may have been
344 impacted because younger individuals contributed less to the data in follow-up measurements
345 throughout the 15-month study. Additionally, these data were collected through the VA, such
346 that the patient population may not generalize to other settings. Similarly, the availability of
347 psychiatric treatment services may be higher compared to a non-VA sample. However,
348 systematic reviews demonstrate that VA-provided health care is similar to care provided in non-
349 VA health systems (Trivedi et al., 2011). Fourth, we did not include other common forms of
350 treatment (i.e., inpatient or outpatient SUD treatment) to the model which may have impacted all
351 of the outcomes and future investigations will be needed to examine the impact of these
352 variables. Fifth, we chose to implement the 2-step approach (i.e., classify-analyze) to examine
353 differences between classes despite some recommendations in the literature against such an
354 approach (Clark and Muthén, 2009). Lastly, growth mixture modeling does not have an agreed
355 upon “gold-standard” regarding model selection rules (Nagin and Odgers, 2010). Hence, we
356 concluded that the 3-class model was the most parsimonious, but other researchers may wish to
357 explain patient classes with less than 10% of the sample or incorporate a p-value on LMR values
358 less stringent than the a priori level of .001. Strengths of this study include the parallel modeling
359 of three clinically distinct factors and high-retention rates among this difficult-to-follow patient
360 sample.

361 In conclusion, employing advanced statistical modeling and using a large clinical sample,
362 this study found that levels of depression and alcohol use declined in a similar and predictable

363 pattern for many patients with co-occurring conditions following psychiatric inpatient care. For a
364 small patient group (11%) of individuals with high and stable depression severity, alternate
365 forms of recovery support may be needed. This is an especially important finding given that AA
366 is commonly recommended by clinicians (Humphreys, 1997). Although we are not suggesting
367 that clinicians discontinue referrals to 12-step mutual-help organizations, they may want to
368 broaden their efforts to include other resources, particularly for patients with high and stable
369 depression. Mutual-help alternatives to AA may provide a better fit for patients with high and
370 stable depression symptoms because of the programs' different foci on how to overcome
371 addiction including secular (Smart Recovery), Christian (Celebrate Recovery), or Buddhist
372 (Refuge Recovery) foundations, their simultaneous focus on both mental health and substance
373 use (e.g., Double Trouble), or their focus on mental health (e.g., Depression and Bipolar Support
374 Alliance). Resources may also include evidence-based treatments for co-occurring MDD and
375 alcohol use disorder (AUD), such as Integrated Cognitive Behavioral Therapy (ICBT). Indeed,
376 among patients with co-occurring MDD and SUD, ICBT may yield more stable clinical
377 outcomes than Twelve-Step Facilitation (TSF) does after treatment has ended (Brown et al.,
378 2006; Worley et al., 2013). TSF modifications may be necessary to facilitate 12-step
379 involvement, reduced drinking, and improved depression symptoms for patients with co-
380 occurring AUD and MDD. Additionally, future clinical investigations may examine the role of
381 medications for MDD and how they may impact alcohol-related outcomes among people who do
382 and do not attend mutual-help organizations regularly.

383 In sum, this study identifies multiple pathways to recovery among this patient group with
384 co-occurring disorder and offers guidance regarding AA referrals and other potential help
385 sources for clinicians. Specifically, increased AA involvement may be helpful to those with
386 indicators of more severe conditions and less critical for those with less severe conditions.

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513

514 **Figure Legends**

515 Figure 1. A statistical diagram of the simultaneous parallel growth mixture model. Though not
516 pictured for sake of simplicity, potential quadratic and cubic equations were estimated for
517 each outcome. All intercepts were set to 1 and slopes set from 0 – 3 for each outcome.

518 Figure 2. Simultaneous 3-class trajectories of depression, AA involvement, and alcohol use
519 outcomes across the 15-month study timeline. High AA n = 109, High Depression n = 42,
520 Low AA n = 248. AA = Alcoholics Anonymous.

521

Table 1

Model fit indices and estimated class size for growth mixture model.

Model	AIC	BIC	Δ BIC	Class Size	Entropy	LMR	LRT	Par.
1 Class	27805	27901		100%				24

2 Class	27190	27388	504	71%, 29%	0.87	640.98*	37
2 Class Revised	27196	27320	68	71%, 29%	0.87	632.97*	31
3 Class	26765	26941	379	61%, 27%, 11%	0.88	443.75*	44
3 Class Revised	26789	26933	8	61%, 27%, 11%	0.88	540.18*	36
4 Class	26600	26795	138	60%, 25%, 8%, 7%	0.88	186.50	49
4 Class Revised	26681	26852	-57	40%, 27%, 23%, 10%	0.78	124.99	43
5 Class	26513	26737	115	35%, 26%, 23%, 9%, 7%	0.79	97.43	56
5 Class Revised	26509	26713	24	38%, 25%, 22%, 8%, 7%	0.79	103.83	51
6 Class	26465	26720	-7	37%, 21%, 17%, 9%, 8%, 8%	0.78	58.68	64

Note: BIC = Bayesian Information Criterion, AIC = Akaike Information Criterion, Δ BIC = change in Bayesian Information Criteria, LMR LRT = Lo-Mendel-Rubin Likelihood Ratio Test, Par. = Parameters in model. Bold line indicates the model chosen as the overall best fitting class. * $p < .001$

522

523

Table 2

Average latent class probabilities for most likely latent class membership (row) by latent class (column).

	1	2	3
1	0.938	0.008	0.054
2	0.009	0.937	0.054
3	0.027	0.019	0.954

Table 3

Class membership and means for select baseline demographic and other variables.

Demographic (SD or %)	Class 1	Class 2	Class 3
	High AA	High Depression	Low AA
Total Individuals in Class	109	42	248
Male Gender	98 (90%)	35 (83%)	229 (92%)
Currently Married	13 (12%)	3 (7%)	47 (19%)
White Race	62 (56%)	26 (61%)	164 (66%)
Age Mean	46.17 (12.11)	47.05 (11.51)	43.79 (10.34)
Age of First Use	13.87 (4.44)	14.69 (3.43)	14.81 (2.67)
Currently Homeless	14 (13%)	5 (12%)	34 (14%)
Average Years of Education	13.72 (1.89)	13.62 (2.64)	13.36 (3.59)
Currently Employed	48 (44%)	19 (45%)	118 (48%)
Previous Outpatient Treatment	5.55 (6.92) _a	2.29 (3.94)	1.34 (4.28) _a
Lifetime Months Incarcerated	20.01 (59.72) _a	14.45 (30.26)	8.72 (30.90) _a
Continued to Drink Even Though it Caused Mental or Health Problems	72 (66%) _a	39 (93%) _{ab}	143 (58%) _b
Total Income Past 30 Days	1988.15 (2123.23)	1707.10 (1414.67)	1825.85 (3572.17)
Spent on Alcohol Past 30	\$157.99 (257.43)	\$267.74 (540.56) _a	\$98.46 (303.95) _a

Note: AA = Alcoholics Anonymous. Subscripts with identical letters were significantly different from each other using class posterior probabilities and analysis of variance statistical tests at $p \leq .05$.

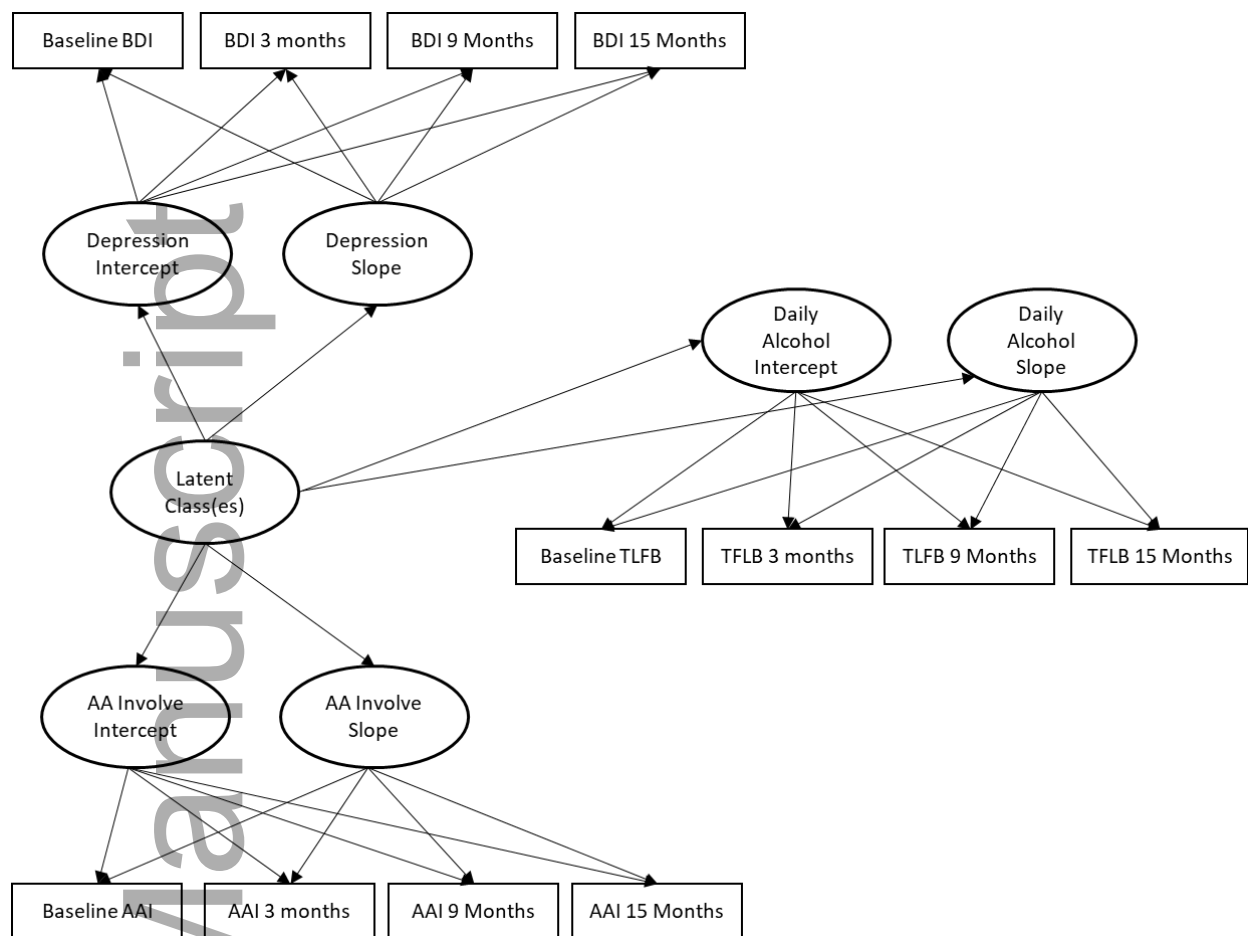


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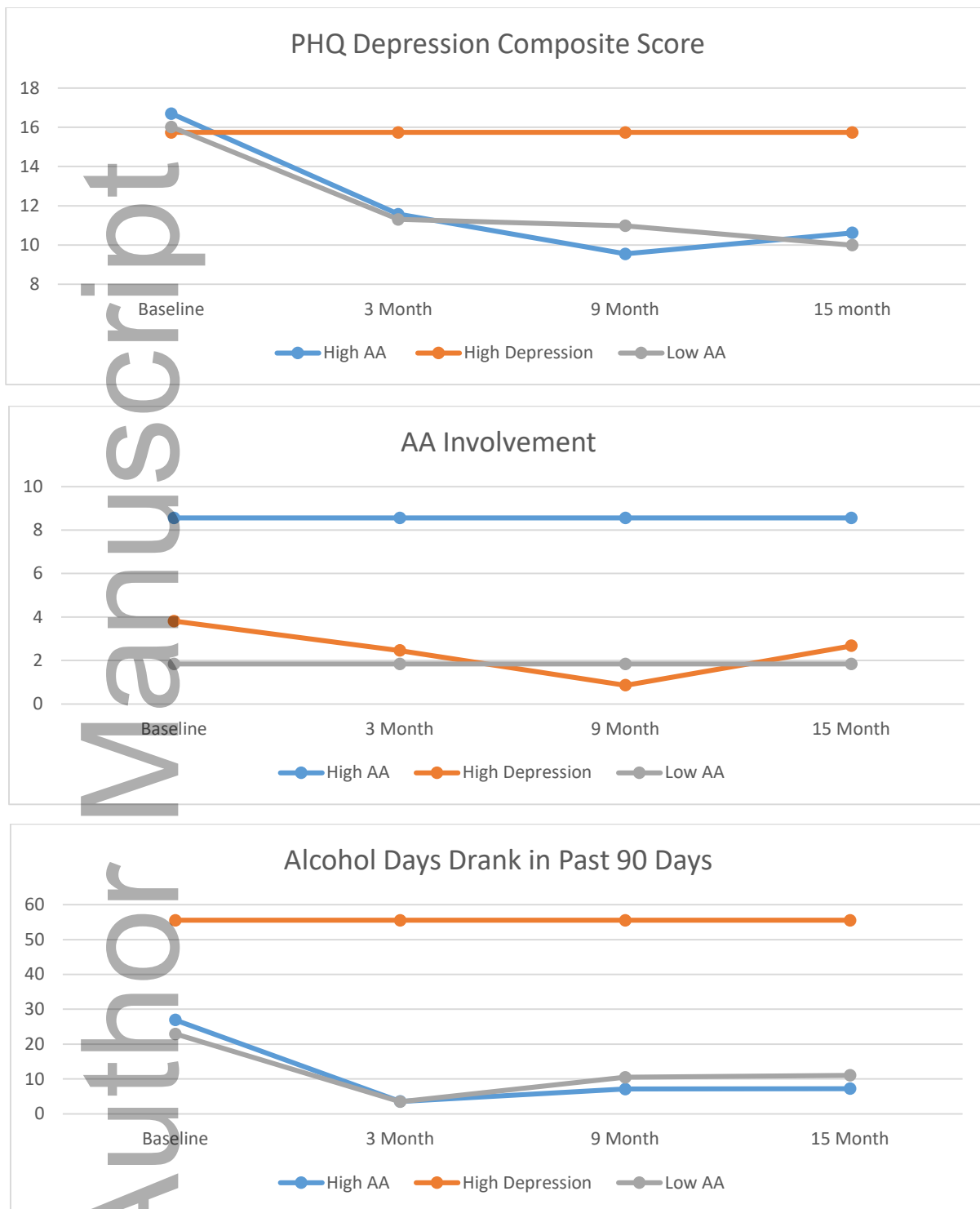


Figure 2. Simultaneous 3-class trajectories of depression, AA involvement, and alcohol use outcomes across the 15-month study timeline. High AA $n = 109$, High Depression $n = 42$, Low AA $n = 248$. AA = Alcoholics Anonymous.