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To cite this article: Anna Mejldal, Kjeld Andersen, Randi Bilberg, Sören Möller & Anette Søgaard Nielsen (2020): DSM-5 Latent Classes of Alcohol Users among Treatment Seeking Older Adults, Substance Use & Misuse, DOI: 10.1080/10826084.2020.1731546

To link to this article: https://doi.org/10.1080/10826084.2020.1731546

Published online: 28 Feb 2020.
DSM-5 Latent Classes of Alcohol Users among Treatment Seeking Older Adults

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ABSTRACT
Objective: Understanding the variation of alcohol use disorder (AUD) among a clinical sample of patients aged 60 and older, by identifying latent classes of AUD and exploring risk factors and outcomes of treatment associated with the class. Method: We used the Danish subsample (n = 341) from the Elderly Study. Latent class analysis was used to identify classes based on the 11 symptoms of DSM-5 AUD. We analyzed the associations between class membership and sociodemographic variables, alcohol consumption, and drinking-related outcome of treatment. Results: Three latent classes were identified. Individuals in the low-symptomatic class (34.85%) displayed low endorsement of DSM-5 criteria "Withdrawal," "Time Spent," "Less activities" compared to the other classes, and had fewest drinks per drinking day. Individuals in the moderate-symptomatic class (32.69%) were most likely to be intoxicated in hazardous situations, and those in the high-symptomatic class (32.47%) displayed, with a few exceptions, the highest probabilities of all DSM-5 criteria. Female gender, living alone and prior AUD treatment was associated with increased risk of being in the high-symptomatic class. No difference between classes was found with respect to years with AUD and frequency of drinking days, and latent class membership had no effect on drinking outcome after treatment, when controlling for baseline. Conclusions: Three classes of DSM-5 AUD among older adults in treatment emerged, displaying a low-moderate-high distribution, advocating for a unidimensional construct of DSM-5 AUD. Although different with respect to baseline risk factors, no strong connection between DSM-5 latent class and alcohol consumption after AUD treatment was found.

HIGHLIGHTS
- Among 341 older alcohol use disorder (AUD) outpatients, three latent classes of DSM-5 AUD emerged.
- The classes of DSM-5 AUD displayed a low-moderate-high endorsement of DSM-5 AUD characteristics.
- The three classes had similar alcohol-related treatment outcomes.

Introduction
In the western world, the number and rates of older adults with alcohol problems are growing (Alpert, 2014; Barry & Blow, 2016), but knowledge about characteristics of DSM-5 alcohol use disorders (AUDs) among older adults is sparse (Behrendt et al., 2018; Kuerbis, Hagman, & Sacco, 2013) and there is still limited research on outcomes of treatment and adapted interventions for this patient group (Andersen et al., 2019; Bhatia, Nadkarni, Murthy, Rao, & Crome, 2015; Kuerbis & Sacco, 2013).

In 2013, the fifth revised version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) was published. While previous versions of DSM had operated with two separate diagnoses for problematic alcohol use (abuse and dependence), DSM-5 introduced a dimensional construct of one single AUD with increasing severity. A tri-categorized severity scale was established, the diagnostic threshold being presented at least two out of potentially 11 symptoms within the last year. Thus, two to three AUD symptoms are considered as mild AUD, four to five symptoms define moderate AUD, and six or more symptoms are considered severe AUD.

The clinical population of individuals with problematic alcohol use is a broad and heterogeneous group, and the proportion of elderly seeking treatment for AUD is growing (Nielsen, Nielsen, Lolk, & Andersen, 2010). Most countries have increased life expectancy and an ageing population, and rates of alcohol use are higher among current and future older adults (Connor, Haber, & Hall, 2016), compared to only a few decades ago. Although they drink less alcohol per year compared to younger adults, they drink...
almost as frequently (Hallgren, Höglberg, & Andreasson, 2009). Older adults may be more exposed than younger to the physiological effects of drinking alcohol, (Anderson, Scafato, & Galluzzo, 2012; Barry & Blow, 2016). Thus AUD is a common health concern, and due to the change in demography, also projected to rise as the number of older adults increases (DiBartolo & Jarosinski, 2017; Han, Moore, Sherman, Keyes, & Palamar, 2017).

Studies have also indicated that the AUDs among the treatment-seeking older adults in general are less severe than what is seen among middle aged and younger individuals, and that treatment of older adults with AUD is more often successful (Lemke & Moos, 2003; Oslin, Pettinati, & Volpicelli, 2002; Satre, Mertens, Arean, & Weisner, 2004; Wieben, Nielsen, Nielsen, & Andersen, 2018). However, the clinical group of older adults is also even more heterogeneous than the clinical group of middle-aged individuals (Fingerhood, 2000; Kuerbis, Moore, Sacco, & Zanjani, 2016), since it – not surprisingly – include both alcohol problems arising late in life and AUD, that has persisted a very long time (Bakshi & While, 2015; Emilussen, Andersen, & Nielsen, 2017; Emilussen, Nielsen, & Andersen, 2017; Fingerhood, 2000). Thus, it is likely that there are distinct classes to be identified in the clinical group of older adults, and that those may be helpful in treatment planning. To our knowledge, no study has yet examined the functioning of DSM-5 AUD in a clinical sample of older adults, and how it relates to outcome of treatment.

Two main statistical methods have developed to characterize and validate functioning of severity scales like DSM-5 AUD: factor analysis and latent class analysis (LCA). Studies using factor analysis, a variable-centered approach which focuses on the underlying constructs represented by symptoms measured, suggest that DSM-5 has an unidimensional structure e.g. (Castaldelli-Maia et al., 2015; Kuerbis et al., 2013; Newton, Slade, McBride, Grove, & Teesson, 2011). This finding describes, however, the functionality of DSM items, and not the population on which DSM is applied.

In LCA, a person-centered approach, the goal is to create and characterize a discrete latent variable based on a cross-classification of the observed responses to symptoms by individuals within the sample. The LCA method assumes that a number of mutually exclusive latent subtypes may be used to represent the symptom endorsement profiles of each subject (McCutcheon, 1987).

Following the revised version of DSM, four studies have explored the heterogeneity of DSM-5 symptoms by means of LCA in a few, distinct populations, ranging from samples of college students to past year drinkers in the US and Brazil (Casey, Adamson, & Stringer, 2013; Castaldelli-Maia et al., 2014; Rinker & Neighbors, 2015; Swift et al., 2016). Finding between 2 and 4 latent subgroups, common for all four studies was a class structure representing the low-moderate-high distribution of DSM-5 AUD symptoms. Yet so far, no studies have investigated DSM-5 symptoms in clinical samples by means of LCA, and the question remains whether there are any, fewer or additional latent subtypes among those who enter treatment for AUD, and if these potential subtypes differ in their response to treatment.

This article presents the first study on the typology of older adult DSM-5 AUD symptoms using a clinical sample, namely a sample of Danish adults age 60 and above from the Elderly study (Andersen et al., 2015) and relating outcomes of treatment to the found classes.

The objective of this study was to 1) examine whether there were distinct classes of older adults in treatment on DSM-5 AUD, and 2) determine whether demographic factors as age, sex, cohabiting with significant others and education, but also frequency and quantity of alcohol use and prior treatment are associated with class membership; and 3) investigate whether the found classes are related to drinking-related outcome of treatment.

Method

Sample

The data for this study stem from the baseline assessment of the Danish part of the ELDERLY Study, one of the RESCueH studies (Søgaard Nielsen et al., 2016). Detailed information about the overall study is provided in Andersen et al. (2015) and the primary outcome of the overall study is presented (Andersen et al., 2019). In addition, specific AUD details from the Elderly Study can be found in Behrendt et al. (2018).

Briefly, the Elderly study developed and tested an outpatient behavior therapy program for AUD according to DSM-5 for adults aged 60 or older. The study was conducted as a multi-center blinded, randomized controlled trial at six different sites (Denmark: Copenhagen, Odense, Aarhus; United States: Albuquerque; Germany: Munich, Dresden) between spring 2014 and spring 2017. A total of 341 patients were enrolled in the three outpatient clinics participating in Denmark. Enrolled patients were randomized to either Motivational Enhancement Therapy (MET), or MET with an add-on session based on the Community Reinforcement Approach (CRA). A series of assessment instruments, including the Mini International Neuropsychiatric Interview (M.I.N.I.), the Form-90, and WHO Quality of Life, were collected at different time points (baseline, 4 weeks, 12 weeks, 26 weeks, 52 weeks) for every participant. In this article, we utilize data from the baseline and 26 weeks assessment.

Measures

To assess DSM-5 AUD and years of AUD, the M.I.N.I. version 5.0.0 (Sheehan et al., 1998) was used, expanded with two questions on craving in the alcohol section.

The 11 symptoms were TOLERANCE, WITHDRAWAL, drinking more than intended (LOSS OF CONTROL), unsuccessful attempts to reduce or stop drinking (DESIRED CONTROL), spending a great deal of time getting alcohol or recovering from the effects of alcohol (TIME SPENT), giving up important activities (LESS ACTIVITIES),
continuing to drink despite physical or psychological health problems (PHYSICAL/PSYCHOLOGICAL), drinking in situations with major role obligations (RESPONSIBLE ROLE), using alcohol in physically hazardous situations (HAZARDOUS SITUATIONS), continued use despite social problems (SOCIAL/INTERPERSONAL), and CRAVING.

Prior treatment was assessed by the tailor-made question “Have you ever been in treatment (inpatient or outpatient) for addiction problems in the past?” and refers to any kind of addiction problem.

Drinking measures were assessed by Form-90 (Miller & Boca, 1994). We calculated drinking days and drinks per drinking day over a 30-day period by using day 60-31 before baseline and the 30 days before 26-weeks follow-up. At baseline, we deemed this approach of using days 60-31 to give a more precise picture of patients’ pretreatment alcohol consumption, considering that the decision to enter treatment and first contact may have an immediate impact on alcohol consumption amount and pattern, combined with the fact that the first contact to the outpatient clinic can be up to three weeks prior to entering treatment and conducting the baseline assessment.

**Statistical analysis**

LCA (McCutcheon, 1987) was used to find distinct latent DSM-5 classes based on the 11 DSM-5 AUD symptoms. In the beginning of the study, there was a misunderstanding between the interviewers. If the participant met criteria of DSM-IV dependence, some of the interviewers did not ask for the abuse and craving criteria of the DSM-5 questionnaire and therefore have missing items. Information from $n = 57/341 (16.7\%)$ was missing for “Responsible role”, “social/interpersonal”, and “hazardous situations”, and from $n = 43/341 (12.6\%)$ for “Craving”. Hence, the missingness of these items is related to some of the observed data and were assumed to be missing at random (MAR). The Expectation Maximization algorithm used gives in this case consistent, asymptotically efficient and asymptotically normal estimates (Lanza, Collins, Lemmon, & Schafer, 2007).

To select the appropriate number of classes and maximize model fit, one to six-class models were fit to the data and compared. We examined several test statistics to determine the best fitting model: the Bayesian Information Criterion (BIC), the Akaike information criteria (AIC), the Consistent Akaike Information Criterion (CAIC), and the sample-size-adjusted BIC (SABIC). We also utilized the bootstrap likelihood ratio test (BLRT) (Dziak & Lanza, 2016) as it proves to be a very consistent statistical indicator for deciding on the number of classes (Nylund, Asparouhov, & Muthén, 2007).

We evaluated the final model fit by examining the variable-specific entropy contribution (Entropy), the average posterior probabilities (AvePP), and evaluating fulfillment of the local independence assumption. For entropy, values >0.80 indicate a good classification of cases into classes, while AvePP values >0.70 indicate well-separated classes (Nylund-Gibson & Choi, 2018). The local independence assumption, assuming local independence of the indicator variables conditional on class membership, was relaxed in cases where it was violated ($p < 0.05$) to allow for direct effects between indicators as recommended in Hagenaars (1988) and Vermunt and Magidson (2016).

We used the “3-step method with covariates or distal outcomes” (3-step method) approach implemented in LatentGold (Bakk, Tekle, & Vermunt, 2013; Vermunt, 2010) to estimate the association between covariates characterizing the classes separately for each covariate or distal outcome.

The covariates at baseline were demographic variables age, sex, cohabiting with a significant other, having more than 10 years of education, number of DSM-5 symptoms endorsed, years of AUD and prior treatment reported at baseline. Furthermore, the number of days drinking the past 30 days and mean drinks per drinking day were chosen both as baseline covariates and distal outcomes at the 26-week follow-up. The 3-step method utilizes a bias-adjusted method to determine covariate effects which is recommended over standard methods (Heron, Croudace, Barker, & Tilling, 2015), especially in the case of low entropy. For all covariates and distal outcomes, we chose proportional maximum
likelihood as estimation technique, except in the case of continuous distal outcomes, where the proportional BCH method was preferred, since it is less sensitive to violations of distributional assumptions (Vermunt & Magidson, 2016).

Finally, to understand whether eventual differences per class on drinking outcomes persisted, even when adjusting for the equivalent baseline drinking measure, we conducted linear regressions on complete cases, assigning patients to classes based on their highest posterior probability. This is shown to be a conservative method which underestimates the relationship between outcome and class membership (Vermunt, 2010). However, it was the most feasible approach, since the 3-step approach, described above, does not allow mixtures of distal outcome and covariates.

All statistical analyses were conducted in Stata 15 and LatentGold 5.1 (Vermunt & Magidson, 2016).

Results

Baseline characteristics

As presented in Table 1, the median number of drinks per drinking day (1 drink = 12 gram of pure alcohol) was 8.4 for the whole sample, and the median number of drinking days per month was 26 for the total sample. Over half of the total sample reported having had prior treatment, and the median age of AUD onset was 47 years.

Of the total sample, only 7% met criteria for a mild AUD, 19.2% met criteria for a moderate AUD, and by far the largest part of the sample, 73.8%, met the criteria for a severe AUD according to DSM-5.

Results of fitting the latent class models

LCA models with 1–6 classes were estimated (Table 2). The statistical indicators were inconclusive, with the BIC and CAIC favoring the 2-class model, the AIC the 4-class model, and the SABIC the 3-class model. The BLRT did provide evidence for a 3-class model, and no evidence for a 4-class model on a p < 0.05 level (p = 0.07). Therefore, the 3-class model was chosen as final solution.

Entropy for the final 3-class model was low at 0.59 which indicates that class separation is not at a very high level. On the other hand, AvePP ranged from 0.80 to 0.83 indicating that although not all patients’ DSM-5 AUD patterns were perfectly represented by the three classes, allocation to the classes has a high level of certainty.

Best solution characteristics

The class proportion and response probabilities for each of the 11 DSM-5 symptoms can be seen in Table 3 and are additionally visualized in Figure 1. The three classes were labeled Class 1, the “low symptomatic class” (corresponding to 34.85% of the participants); Class 2, the “moderate symptomatic class” (corresponding to 32.69% of the participants); and Class 3, the “high symptomatic class” (corresponding to 32.47% of the participants).

For each of the 11 DSM-5 symptoms, Class 1, the “low symptomatic class”, had slightly lower probabilities of endorsement than Class 2 and generally lower probabilities of endorsement than Class 3. Significantly lower probabilities than both Class 2 and Class 3 were found for DSM-5 symptoms “Withdrawal”, “Time Spent”, “Less activities”. Class 1 had a significant lower probability than Class 2 for DSM-symptoms “Social/Interpersonal”, while there was a significant difference in Class 3 on “Tolerance”. Especially low, though not significantly different from the other classes, were the two symptoms “Hazardous situations” (0.23%) and “Responsible role” (0.99%), indicating that participants in this group very seldom drank in situations where they were physically at risk or had problems with their alcohol intake in connection with situations, where they carry a responsibility.

Class 2, the “moderate symptomatic class”, was characterized by having medium-high probabilities of endorsing each of the 11 DSM-5 symptoms. Significant differences were found for “Tolerance”, where the likelihood of meeting this criterion was significantly lower than Class 3; on the other hand, there was a significantly higher probability of meeting the symptoms “Hazardous situations”. For symptoms “Time spent” and “Withdrawal”, this class had both significantly higher probabilities than Class 1 and significantly lower probabilities of endorsement than Class 3. Furthermore, there were significant differences to Class 1 on the symptoms “Less activities” and “Social/Interpersonal”, where participants in Class 2 were more likely to meet these symptoms. Individuals in this class were very likely to continue drinking despite physical or psychological problems (86.78%) and experiencing social or interpersonal problems (86.89%) and had the highest probabilities of all three classes of endorsing the symptoms “Hazardous situations” (33.87%) and “Responsible role” (38.55%).

Class 3, the “high symptomatic class”, with few exceptions, had the highest probability of endorsing any one

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Table 2. Model fit statistics.

<table>
<thead>
<tr>
<th></th>
<th>LL</th>
<th>BIC(LL)</th>
<th>AIC(LL)</th>
<th>CAIC(LL)</th>
<th>SABIC(LL)</th>
<th>df</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Cluster</td>
<td>-1959.98</td>
<td>3984.11</td>
<td>3941.96</td>
<td>3995.11</td>
<td>3949.22</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>2-Cluster</td>
<td>-1879.18</td>
<td>3892.49</td>
<td>3804.36</td>
<td>3915.49</td>
<td>3819.53</td>
<td>318</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3-Cluster</td>
<td>-1859.28</td>
<td>3922.67</td>
<td>3788.56</td>
<td>3957.67</td>
<td>3811.65</td>
<td>306</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>4-Cluster</td>
<td>-1845.18</td>
<td>3964.46</td>
<td>3784.36</td>
<td>4011.46</td>
<td>3815.37</td>
<td>294</td>
<td>0.07</td>
</tr>
<tr>
<td>5-Cluster</td>
<td>-1834.60</td>
<td>4013.29</td>
<td>3782.21</td>
<td>4072.29</td>
<td>3826.13</td>
<td>282</td>
<td>0.32</td>
</tr>
<tr>
<td>6-Cluster</td>
<td>-1826.02</td>
<td>4066.11</td>
<td>3794.05</td>
<td>4137.11</td>
<td>3840.89</td>
<td>270</td>
<td>0.49</td>
</tr>
<tr>
<td>3-Cluster with adjustment**</td>
<td>-1844.50</td>
<td>3916.44</td>
<td>3766.99</td>
<td>3955.44</td>
<td>3792.72</td>
<td>302</td>
<td>&lt;0.001***</td>
</tr>
</tbody>
</table>

* p Value from the BLRT.
** direct effects between (Loss of Control and Less activities), (Loss of Control and Craving), (Physical/Psychological and Tolerance), (Physical/Psychological and Interpersonal).
*** compared to 3-cluster without adjustments, 4 Cluster BLRT p value was 0.48 over adjusted 3-cluster.
DSM-5 symptom, with significant differences to Class 1 on the symptoms “Less activities” and “Physical/Psychological”, to Class 2 on the symptoms “Hazardous situations”, and to both other classes on “Tolerance”, “Withdrawal” and “Time spent”. The probability of all symptoms was above 70%, apart from “Hazardous situations” (11.65%) and “Responsible role” (30.95%). Nearly all individuals in this group experienced irresistible craving (99.19%), and related to this, drinking more than they intended (99.27%) and continuing to drink despite having physical or psychological problems (95.00%).

Comparison of covariates and outcomes across classes

The distribution of covariates by expected latent class membership (Table 4) revealed several differences between classes.

Generally, patients most likely belonging to Class 1 and Class 2 did not differ from each other significantly on most covariates. Only exception was gender, where individuals most likely classified in Class 2 were less likely to be female (18.0%) compared to Class 1 (37.0%) and Class 3 (52.3%). Likewise, all three classes differed in the mean number of DSM-5 symptoms endorsed, going from 4.4 symptoms at average in Class 1 to 6.8 symptoms in Class 2 and 8.5 symptoms in Class 3. In addition, Class 1 had significantly fewer drinks per drinking day (7.5) compared to Class 2 (10.5) and Class 3 (11.2).

Of the individuals most likely classified in Class 3, significantly fewer were living with a significant other (26.0%), compared to Classes 1 (52.6%) and 2 (54.4%).

On the other hand, individuals most likely classified in Class 3 had a significantly higher probability of having had prior treatment (77.8%), compared to Class 2 (60.5%) and Class 1 (48.4%).

Finally, we examined the distribution of outcomes at the 26-weeks follow-up by expected class membership (Table 5). Patients most likely in Class 2 did not differ significantly from the two other groups. Patients in Class 1 had significantly more drinking days (12.2) than Class 3 (7.1).

Linear regression on complete data with the modal assignment found similar effects of class as in Table 5 in the

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Class 1 “low symptomatic”</th>
<th>Class 2 “moderate-symptomatic”</th>
<th>Class 3 “high symptomatic”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tolerance</td>
<td>34.85%</td>
<td>32.69%</td>
<td>32.47%</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>57.88%</td>
<td>55.1%</td>
<td>79.31%</td>
</tr>
<tr>
<td>Loss of control</td>
<td>49.62%</td>
<td>74.12%</td>
<td>88.9%</td>
</tr>
<tr>
<td>Desired control</td>
<td>70.53%</td>
<td>72.85%</td>
<td>99.27%</td>
</tr>
<tr>
<td>Time spent</td>
<td>72.67%</td>
<td>78.83%</td>
<td>82.9%</td>
</tr>
<tr>
<td>Less activities</td>
<td>14.99%</td>
<td>66.42%</td>
<td>11.65%</td>
</tr>
<tr>
<td>Physical/Psychological</td>
<td>23.19%</td>
<td>45.00%</td>
<td>98.72%</td>
</tr>
<tr>
<td>Responsible role</td>
<td>71.61%</td>
<td>86.78%</td>
<td>95.00%</td>
</tr>
<tr>
<td>Hazardous situations</td>
<td>2.3%</td>
<td>3.8%</td>
<td>11.65%</td>
</tr>
<tr>
<td>Social/Interpersonal</td>
<td>55.36%</td>
<td>86.89%</td>
<td>77.2%</td>
</tr>
<tr>
<td>Craving</td>
<td>78.27%</td>
<td>78.97%</td>
<td>99.19%</td>
</tr>
</tbody>
</table>

In each column, superscript numbers indicate significant differences between latent classes regarding the specific criteria.
unadjusted models, however, no effect of latent class on follow-up drinking days (Class 2: $\beta = -1.28$, 95% CI $[-4.59; 2.03]$, $p = 0.446$; Class 3: $\beta = -3.05$, 95% CI $[-6.10; 0.00]$, $p = 0.050$; Class 1 as reference) were found when adjusting for the corresponding baseline covariate (detailed results can be provided at request).

### Discussion

This is the first LCA study of DSM-5 symptoms on older adults in AUD treatment. The objective of the study was to examine if there were distinct classes of older adults with AUD based on DSM-5 AUD symptoms and whether membership in those classes was associated with specific covariates or would have any implications on outcome of treatment.

Overall, our findings indicate that there are three classes of about the same size of treatment seeking older adults within DSM-5 AUD, roughly representing the low-moderate-high distribution. We also found that class separation is not at a high level, this contributes to the idea of a unidimensional construct of DSM-5 AUD. The distribution of DSM-5 AUD was highly skewed in our sample with 73.8% having severe AUD. One could speculate, given a unidimensional structure, that with a larger sample consisting of more individuals with mild AUD, we would probably find more classes representing groups with increasing severity of DSM-5 AUD. Furthermore, this is in line with the few other population-based studies which also support a unidimensional model, identifying unobserved classes of individuals who differ in relation to severity, rather than the pattern, of the diagnostic criteria they encounter (Casey et al., 2013; Castaldelli-Maia et al., 2014; Rinker & Neighbors, 2015). Differing on the fact that our study investigates a clinical sample, of which all are diagnosed with AUD by DSM-5, this additionally advocates for a unidimensional structure of DSM-5, even in subsamples of the general population.

The only DSM-5 symptoms which differed significantly between all three groups were “Time spent” and “Withdrawal”, implying that the more severe the AUD, the higher the probability of spending substantial time in obtaining alcohol, drinking, or in recovering from the effects of alcohol. Compared to this, it seems that the probability of having drinking-related social or interpersonal problems, spending less time working, enjoying hobbies or being with others already rises to a high level when going from the “low symptomatic” to the “moderate symptomatic” Class. On the other hand, the likelihood of increased tolerance first seems to accelerate when going from the “moderate symptomatic” to the “high symptomatic” Class.

Other salient findings relate to the distribution of covariates across the latent classes. The “high symptomatic” Class were living more alone and had more often had prior treatment, which is also supported by other studies (Colpaert, De Maeyer, Broekaert, & Vanderplasschen, 2013; Kirouac, Stein, Pearson, & Witkiewitz, 2017).

At the same time more than half of this class were female, which was significantly more than in the other two groups, and double the percentage of Class 2, the “moderate symptomatic class”. There is evidence that women with substance use disorders, in general, are less likely than their male counterparts to enter treatment over their lifetime e.g. (Alvanzo et al., 2014; Khan et al., 2013), and less likely to enter specific AUD outpatient treatment (Edlund, Booth, & Han, 2012). This higher threshold for entering treatment could lead to a selected group of women with more severe AUD in treatment, and in course explain the higher percentage of women in the “high symptomatic class”.

Furthermore, women generally experience more biological and social consequences of drinking than men (Lev-Ran, Le Strat, Imtiaz, Rehm, & Le Foll, 2013; Nolen-Hoeksema & Hilt, 2006) and, compared to men, women in AUD treatment are seen to experience increased complications in domains of employment, medical and psychiatric functioning (Foster, Peters, & Marshall, 2000; Hernandez-Avila,

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### Table 4. Distribution of covariates.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Class 1 “low symptomatic”</th>
<th>Class 2 “moderate-symptomatic”</th>
<th>Class 3 “high symptomatic”</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (female, %)</td>
<td>37.0$^{2,3}$</td>
<td>18.0$^{3,1}$</td>
<td>52.3$^{2,1}$</td>
<td>0.0019</td>
</tr>
<tr>
<td>Age in years, mean</td>
<td>64.9</td>
<td>65.4</td>
<td>65.1</td>
<td>0.66</td>
</tr>
<tr>
<td>Cohabiting (%)</td>
<td>52.6$^{3}$</td>
<td>54.4$^{3}$</td>
<td>26.0$^{2,1}$</td>
<td>0.0014</td>
</tr>
<tr>
<td>Education (10 years or more, %)</td>
<td>50.4</td>
<td>41.0</td>
<td>38.3</td>
<td>0.15</td>
</tr>
<tr>
<td>Alcohol related measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of drinking days over 30 days, mean</td>
<td>21.5</td>
<td>20.7</td>
<td>18.5</td>
<td>0.31</td>
</tr>
<tr>
<td>Drinks per drinking day over 30 days, mean</td>
<td>7.5$^{2,3}$</td>
<td>10.5</td>
<td>11.2$^1$</td>
<td>0.0014</td>
</tr>
<tr>
<td>Prior treatment (Yes, %)</td>
<td>48.4$^3$</td>
<td>60.5$^3$</td>
<td>77.8$^{2,1}$</td>
<td>0.00089</td>
</tr>
<tr>
<td>Years of AUD, mean</td>
<td>19.2</td>
<td>19.2</td>
<td>20.1</td>
<td>0.84</td>
</tr>
<tr>
<td>Number of DSM-5 AUD criteria endorsed, mean</td>
<td>4.4$^{2,3}$</td>
<td>6.8$^{3,1}$</td>
<td>8.5$^{2,1}$</td>
<td>$&lt;0.001$</td>
</tr>
</tbody>
</table>

In each column, superscript numbers indicate differences between latent classes on log-odds or mean outcome ($p < 0.05$) based on Wald chi-square tests.

### Table 5. Distribution of drinking-related outcomes 6 months after baseline.

<table>
<thead>
<tr>
<th>Alcohol related measures 6 months after baseline</th>
<th>Class 1 “low symptomatic”</th>
<th>Class 2 “moderate-symptomatic”</th>
<th>Class 3 “high symptomatic”</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of drinking days over 30 days, mean</td>
<td>12.2$^1$</td>
<td>9.6</td>
<td>7.1$^1$</td>
<td>0.038</td>
</tr>
<tr>
<td>Drinks per drinking day over 30 days, mean</td>
<td>3.4</td>
<td>5.5</td>
<td>4.1</td>
<td>0.22</td>
</tr>
</tbody>
</table>

In each column, superscript numbers indicate differences between latent classes on log-odds or mean outcome ($p < 0.05$) based on Wald chi-square tests.
Rounsaville, & Kranzler, 2004), which could also contribute to the overrepresentation of women in the "high symptomatic class", as DSM-5 covers all of these aspects.

No differences were found between latent classes with respect to the reported number of years of AUD, although the most severe class displayed the highest probability of prior treatment. This could indicate that AUD does not develop over time in severity but may have distinct severity classes that occur separately.

Finally, we found no differences across latent classes in the mean number of drinking days at baseline, and although there was a difference detected in number of drinking days at follow-up, this difference was not significant when adjusting for baseline. Combining this with the fact that the number of drinks per drinking day was only significantly lower for the "low symptomatic" class at baseline, indicates that alcohol consumption frequency and quantity are not necessarily clearly related to DSM-5 AUD severity. Similar results on the association between consumption patterns and AUD diagnostic can be found in (Dawson, 2000; Keyes, Geier, Grant, & Hasin, 2009; McBride, Teessoss, Baillie, & Slade, 2011).

Limitations

The sample is restricted to a population of treatment seeking older adults, which inhibits the generalization of our study to a general population of older adults with regular drinking habits or with AUD. Furthermore, the sample size is relatively small. This can also be the cause of another limitation, namely that entropy in the LCA model estimated is low, indicating that the classes are not that distinguishable. Lastly, due to software restrictions, all tests of continuous covariates ignore the fact that these are not necessarily normally distributed. This is convenient and asymptotically valid, but not statistically efficient.

Conclusion

LCA identified three groups of roughly equal size of older adults with AUD in a clinical sample, with distinctive sociodemographic characteristics. The results support a unidimensional model of DSM-5 AUD severity, identifying unobserved classes of individuals who differ in relation to severity, rather than the pattern of the diagnostic criteria.

Acknowledgements

We acknowledge the contribution of all study participants, therapists, interviewers, and student helpers.

Declaration of interest

No potential conflict of interest was reported by the authors.

Funding

This study was funded by the Lundbeck Foundation, Denmark, which had no role in study design, collection, analysis and interpretation of data, writing of the report, and decision to submit the article for publication.

References


