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Interpersonal and Intrapersonal Emotional Processes in Individuals Treated for Alcohol Use Disorder and Non-Addicted Healthy Individuals

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Abstract

Introduction—Prior work largely confirms the presence of various emotional processing deficits among individuals with an alcohol use disorder (AUD); however, their specificity and relevance still warrant investigation. The aim of the current study was to compare selected aspects of emotional processing (i.e., mental state recognition, alexithymia, and emotional intelligence) between individuals treated for an AUD and healthy individuals.

Methods—The AUD sample consisted of 92 abstinent men with AUD who were participating in an 8-week inpatient abstinence-based treatment program in Warsaw, Poland. The healthy control (HC) group consisted of 86 men recruited from the Medical University of Warsaw and the Nowowiejski Hospital administrative staff. Baseline information about demographics, psychopathological symptoms, and severity of alcohol problems was obtained. Mental states recognition was assessed using the Reading the Mind in the Eyes Test (RMET). Alexithymia was measured with the Toronto Alexithymia Scale (TAS-20). The Schutte Self-Report Emotional Intelligence Test (SSEIT) was used to measure emotional intelligence (EI).

Results and Conclusions—After accounting for potentially confounding variables (demographics, severity of depression, anxiety symptoms) in MANCOVA models, patients with AUD presented deficits in identification and description of their own emotional states, as well as lower emotion regulation skills when compared to HCs. No between-group differences were observed in self-reported recognition of other people's emotions, social skills, and a behavioral measure of mental states recognition. Specific rather than general emotion-processing deficits in

participants with AUD were identified, suggesting problems with processing of intrapersonal emotional signals.

Keywords

alcohol dependence; emotion recognition; alexithymia

Introduction

Effective social interactions are based on the ability to accurately perceive, correctly express, and appropriately react to one's own emotional states as well as those expressed by others (Feldman & Rimé, 1991). Individuals with alcohol use disorder (AUD) demonstrate deficits in processing inter- and intrapersonal emotional signals (Maurage, Timary, & D'Hondt, 2017). Moreover, individuals with AUD have difficulties responding appropriately in social situations, which cause serious interpersonal problems (Nixon, Tivis, & Parsons, 1992). Interpersonal problems, in turn, are related to emotional decoding deficits among individuals with AUD (Kornreich et al., 2002). Problems with the processing of inter- and intrapersonal emotional signals among this group are especially problematic given that effective emotion regulation is perceived as necessary to successfully complete AUD treatment (Moos & Moos, 2006). In fact, it has been shown that more than half of post-treatment relapses are related to emotional and interpersonal factors (Zywiak, Westerberg, Connors, & Maisto, 2003).

Alexithymia is considered a deficit in the cognitive processing of emotion and an impairment in the mental representation of emotions (as feelings), which limits the capacity to regulate emotions through cognitive processes. As a result, those with alexithymia tend to experience high physiological arousal. According to Taylor (1997), alexithymia is a multifaceted construct characterized by: affective and cognitive deficits in identifying and describing one's own emotional states, impoverished inner emotions, and a concrete cognitive style. Difficulty in identifying and describing one's own feelings – the primary feature of alexithymia – is recognized in 50% to 78% of individuals with an AUD (Thorberg, Young, Sullivan, & Lyvers, 2009) in comparison to 10% of individuals in the general population (Hiirola et al., 2017). These rates may indicate problems with processing of intrapersonal emotional information among those with an AUD. Kauhanen and colleagues (1992) observed that long-term heavy alcohol use was related to alexithymia in Finnish men. Furthermore, the authors observed that men with alexithymia drink more than men without alexithymia, perhaps as an effort to cope with negative affect. This is consistent with other work indicating that unpleasant arousal typically experienced by individuals with alexithymia might lead to maladaptive coping behaviors, including excessive alcohol consumption (Thorberg et al., 2011). Moreover, Finn and colleagues (1987) suggest that drinking alcohol may facilitate verbal and emotional interpersonal communication among individuals with alexithymia who tend to feel incompetent in these areas. Drinking alcohol may increase access to greater emotional states, making this substance particularly reinforcing for individuals experiencing both an AUD and alexithymia (Thorberg et al., 2009). Conversely, it is also plausible that alexithymia may develop as a long-term consequence of heavy consumption of alcohol through its adverse effects on brain structures

involved in cognitive regulation of emotional processes (e.g., the amygdala and the anterior cingulate cortex; Kober, 2014).

Deficits in accurate recognition and labeling of other peoples' facial expressions – critical in interpersonal interactions – have also been examined in participants with AUD (Castellano et al., 2015). Research shows that beyond simple facial affect recognition, individuals with AUD also exhibit more complex variability in social perception and social cognition - Theory of mind (ToM) – deficits (Onuoha, Quintana, Lyvers, & Guastella, 2016). ToM, also referred to as mentalizing, is the ability to ascribe complex mental states (desires, beliefs, feelings) to oneself and to other people to make predictions about other peoples' behavior in social situations (Premack & Woodruff, 1978). Even though a recent study (Onuoha et al., 2016) supports *general ToM impairment* in AUD participants, results of studies on the *social perceptual component of ToM* are less straightforward. In some studies, the differences in mental state recognition between individuals with AUD and healthy controls (HCs) were significant (Thoma, Winter, Juckel, & Roser, 2013), whereas in others, differences were not apparent (Kornreich et al., 2011).

The above interpersonal and intrapersonal emotional processes are also viewed as basic components of emotional intelligence (EI). EI is conceptualized as emotional competencies such as recognition, regulation, and utilization of self and others' emotions in thinking or acting (Salovey & Mayer, 1990). Preliminary data suggests that individuals with AUD have lower EI compared to controls, but more work is necessary to make definitive conclusions (Peterson, Malouff, & Thorsteinsson, 2011). Among the EI components, problems with emotion regulation are thought to be the primary motives for alcohol use, as well as a core emotional feature of alcohol dependence (Petit et al., 2015). For some individuals with AUD, alcohol intoxication may help regulate current emotional states temporarily by increasing positive affect and decreasing negative affect (Kober, 2014). The long-term reliance on alcohol use to regulate emotions could have a negative impact on structures related to affect regulation (e.g., prefrontal cortex), which could result in blunting of emotions and worsen emotion regulation capabilities (Kober, 2014). Preliminary data shows that emotion regulation impairments may be associated with adverse outcomes in individuals with AUD. Deficits in the utilization of emotions predicted poorer post-treatment outcomes in those treated for AUD (Kopera et al., 2014), and poor emotion-regulation skills predicted post-treatment alcohol use during follow-up (Berking et al., 2011).

Although prior work confirms emotional processing deficits in AUD, its specificity and clinical relevance needs additional investigation. Research suggests that at the intrapersonal level, individuals with AUD lack emotional and/or cognitive skills that lead to impaired understanding of their own emotional states (high alexithymia), and they report problems with effective regulation of their inner states. At the interpersonal level, deficits in the recognition of others' mental state are also described in participants with AUD. Currently, few studies investigate intra- and interpersonal emotional processes in the same group of individuals with AUD. One exception, is a study demonstrating that individuals with AUD are more likely to endorse high alexithymia and have more difficulties in social interactions compared to matched controls (Maurage et al., 2017). Yet, the same group also found that individuals with AUD demonstrate heterogeneous presentations of emotional and

interpersonal difficulties, with some characterized by intense alexithymia traits with few interpersonal problems and others characterized by intense interpersonal problems but moderate emotional impairments (Maurage et al., 2017). Thus, further exploration of the specific aspects of intra- and interpersonal emotional and social deficits among individuals with AUD is warranted. A greater understanding of additional dimensions that may help characterize individuals with AUD (e.g., emotional functioning) could help to identify additional subgroups in order to provide tailored alcohol use interventions.

The current study assessed and compared the aforementioned emotional processes (i.e., mental state recognition, alexithymia, and EI) between individuals with AUD and HCs. Based on previous work, we anticipated that individuals with AUD would have deficits in emotion regulation and both inter- and intrapersonal domains, particularly in recognition of their own and others' emotions, compared to that of HCs.

Material and Methods

Participants and procedures

The sample consisted of 92 individuals with AUD who were currently abstinent. Participants were recruited from an inpatient addiction treatment center in Warsaw, Poland that included an 8-week abstinence-based treatment program with intensive group and individual therapy. This study focused on White men, as this was the demographic group that was overrepresented in this center. Participants were between ages 18 and 74. The diagnosis of AUD was based on the International Classification of Diseases and Related Health Problems, 10th Revision (WHO, 1992) using the Mini-International Neuropsychiatric Interview (MINI.; Sheehan et al., 1998). Individuals were not eligible to participate in the treatment program, and the current study in turn, if they met any of the following exclusionary criteria: clinically significant cognitive deficits as determined by a score of less than 25 using the Mini-Mental State Examination (Folstein et al., 1975), severe comorbid mental illness (psychosis, bipolar disorder), major depressive disorder, dementia, current drug abuse or dependence (except for nicotine), as well as drug abuse or dependence in the past, and current symptoms of alcohol withdrawal.

The HC group consisted of 86 men recruited from the Medical University of Warsaw and the Nowowiejski Hospital (Warsaw, Poland) administrative staff. Control participants were excluded if they met criteria for hazardous use of substances, or substance abuse or dependence, excluding nicotine. All of the control participants reported drinking only sporadically (below 40 – 60 g per week). Other exclusion criteria pertaining to the individuals with AUD was also applied to HC group.

The study protocol received approval from the Bioethics Committee at the Medical University of Warsaw, Poland. Participation was confidential and voluntary; all patients were informed of the study protocol and gave written informed consent.

Measures

Questions regarding sociodemographic characteristics (e.g., age, education) were obtained using a self-report questionnaire.

Alcohol use—The Alcohol Use Disorders Identification Test (AUDIT; Babor, de la Fuente, Saunders, & Grant, 1992) assessed hazardous use and screened for symptoms of AUD in healthy controls. The Timeline Follow-Back (TLFB; Sobell, Sobell, Leo, & Cancilla, 1988) interview was used to quantify how many days a participant drank alcohol during the 3 months prior to the baseline assessment. Heavy drinking was defined as more than five standard drinks per day. The duration of problematic alcohol use was self-reported only by individuals with AUD.

Psychiatric comorbidity—Psychiatric comorbidity was assessed with the Polish version of the MINI (Masiak & Przychoda, 1998). It is important to note that antisocial personality disorder (ASPD), although not an exclusion criterion, was assessed and included as a covariate in models given the potential influence that ASPD might have on ToM (e.g., Dolan and Fullam, 2004). More specifically, ASPD was diagnosed in 7 (7.7%) individuals with AUD and 1 (1.2%) HC¹. Cognitive deficits consistent with dementia were screened with the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). Subscale scores for anxiety and depression from the Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983) were included as control measures for current negative affect. The BSI is a 53-item, self-administered questionnaire that is keyed to the past 7 days. The Cronbach's α ranged from 0.87 to 0.97 for BSI total and subscale scores.

Mental states recognition—Reading the Mind in the Eyes Test (RMET; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) was utilized as a measure of mental states recognition. Photographs of the eye region of 36 different faces of men and women expressing a complex mental state - all black and white, with the same region of the face from midway along the nose to just above the eyebrow for each photo - were presented with four adjectives displayed around the photograph. Participants had to choose the best adjective describing a mental state of the person in the photograph. Although timing for the decision was unlimited, participants were instructed to answer as fast as possible. At any time, a glossary with a brief definition of each adjective was available. Based on prior results of studies using RMET, variance in mental states recognition in the task depends on the emotional valence of the items (Harkness, Sabbagh, Jacobson, Chowdrey, & Chen, 2005). Therefore, three valence scores were calculated (following a validated RMET item valence classification; Harkness et al., 2005). A positive emotions score was calculated as the percentage of correct responses for positive emotion items, a negative emotions score was calculated as the percentage correct for negative emotion items, and a non-emotional mental states score was calculated as the percentage of correct responses for neutral items. RMET data for four HCs were missing and therefore not included in analyses.

Alexithymia—The Polish version of Toronto Alexithymia Scale (TAS-20; Cedro, Kokoszka, Popiel, & Narkiewicz-Jodko, 2001) was utilized as a self-report measure of alexithymia. Three component scores were utilized: (1) difficulty identifying feelings (e.g., *"I am often confused about what emotion I am feeling"*); (2) difficulty describing feelings (e.g., *"It is difficult for me to find the right words for my feelings"*); and (3) externally

¹The presence of ASPD did not influence the results.

oriented thinking (e.g., “*I prefer to analyze problems rather than describe them*”). Cronbach α s ranged between 0.60–0.84 for the total TAS score and subscales. Consistent with prior work (Bagby et al., 1994), individuals obtaining an overall TAS-20 score of < 51 were considered to have “low alexithymia,” while those scoring > 61 were considered to have “high alexithymia.”

Emotional intelligence—The Polish version of Schutte Self-Report Emotional Intelligence Test (SSEIT; Jaworowska, Matczak, Ciechanowicz, Stachczak, & Zalewska, 2005) was used as a self-report measure of EI, based on prior work (Salovey & Mayer, 1990). EI is conceptualized as a composite of several emotional skills such as perception, appraisal and expression of emotion; emotional facilitation of thinking; understanding, analyzing and employing emotional knowledge; and reflective regulation of emotions to further emotional and intellectual growth. Prior work on the SSEIT supported a four-factor solution (Saklofske, Austin, & Minski, 2003). Accordingly, four subscales were examined: optimism/mood regulation (e.g., “*I have control over my emotions*”), appraisal of emotions (e.g., “*I know what other people are feeling just by looking at them*”), utilization of emotions (e.g., “*When I feel a change in emotions, I tend to come up with new ideas*”), and social skills (e.g., “*I help other people feel better when they are down*”). Cronbach α s ranged between 0.74–0.88 for the total EI score and subscales.

Data analysis

The study groups (individuals with AUD vs HCs) were first compared in terms of sociodemographic, clinical and drinking characteristics with either a one-way analysis of variance (ANOVA), Mann-Whitney or chi-square test. In subsequent analyses, variables that differed across study groups were included as covariates in a set of one-way between group multivariate analysis of covariance (MANCOVAs) models calculated to investigate the differences in TAS, SSEIT, and RMET. A MANCOVA was utilized due to the correlations between the factor scores within each of the three measured domains (TAS, SSEIT and RMET; range of r s = 0.25–0.69). Preliminary assumption testing was conducted to check for normality, linearity, multivariate outliers, homogeneity of variance and covariance, and multicollinearity, with no serious violations noted. Non-normal distributions were analyzed with non-parametric tests. A Bonferroni correction was applied to the multiple between-group comparisons. The data were analyzed using statistical package SPSS 23.0 for Windows.

Results

Sociodemographic, clinical and drinking characteristics of the individuals with AUD and HC participants are presented in Table 1. Participants with AUD were significantly older ($F [1,176] = 14.75; p < .001$) and less educated ($F [1,170] = 8.52; p < .01$) than HCs. Individuals with AUD also reported greater severity of depressive ($U = 2099.50; p < .001$) and anxiety ($U = 2143.00; p < .001$) symptoms than HCs. The two groups did not differ on either number of drinking days ($U = 3704.00; p = .53$) or number of heavy drinking days ($U = 3522.50; p = .34$) during the last 3 months. The mean (SD) duration of problematic alcohol use in individuals with AUD was 20.64 (11.13) years, and mean (SD) abstinence

length in individuals with AUD was 41.58 (32.68) days. The alexithymia total score between-group comparisons revealed, that there was a significantly higher proportion of “high alexithymia” in individuals with AUD when compared to HCs (49.0% vs 19.8%; chi-square = 31.20; $p < .0001$).

In the first MANCOVA, the three RMET subscales were used as dependent variables in the between-group comparison. After adjusting for covariates (age, education, current anxiety and depression severity), there were no significant between-group differences ($F [3,164] = 1.90$; $p = .13$; Wilks' Lambda = 0.97).

In the second MANCOVA, the three TAS subscales were used as dependent variables in the between-group comparison. After adjusting for covariates (age, education, current anxiety and depression severity), there was a significant between-group difference on the total score of the combined dependent variable ($F [3,167] = 3.43$; $p = .02$; Wilks' Lambda = 0.94, partial eta squared = 0.06). When the results for the dependent variables were considered separately, difficulty describing feelings ($F [1,165] = 9.79$; $p = .002$; partial eta squared = 0.06) was significantly different across groups, while difficulty identifying feelings ($F [1,165] = 5.09$; $p = .02$; partial eta squared = 0.03) was marginally significant using the Bonferroni adjusted alpha level of $p < .016$. An inspection of the mean adjusted scores revealed that individuals with AUD reported more difficulties in describing feelings ($M [SE] = 15.53 [0.41]$ vs $M [SE] = 13.55 [0.43]$; $p = .002$) than HCs, and more difficulties in identifying feelings ($M [SE] = 20.23 [0.66]$ vs $M [SE] = 17.91 [0.70]$; $p = .02$); however, this last effect was only marginal. Differences did not emerge in externally oriented thinking.

In the last MANCOVA, the four SSEIT subscales were used as dependent variables in the between-group comparison. After adjusting for covariates (age, education, current anxiety and depression severity), there was a significant between-group difference on the combined dependent variable ($F [4,166] = 3.36$; $p = .01$; Wilks' Lambda = 0.92, partial eta squared = 0.08). When the results for the dependent variables were considered separately, the only difference to reach statistical significance, using the Bonferroni adjusted alpha level of $p < .01$, was mood regulation ($F [1,165] = 7.37$; $p = .007$; partial eta squared = 0.04). An inspection of the mean adjusted scores revealed that individuals with AUD reported lower mood regulation

Discussion

This study compares aspects of emotional processing between individuals treated for AUD and healthy counterparts. Individuals with AUD reported problems with identification and description of their emotional states, as well as deficits in emotion regulation skills compared to HCs. However, between-group differences in self-reported recognition of other people's emotions, their own social skills, and behaviorally measured mental states recognition were not observed. Thus, the expected general emotion-processing deficit in individuals with AUD was not supported by these findings.

Intrapersonal level of emotion processing

AUD is associated with emotion dysregulation (Kober, 2014) and preliminary data shows that emotion regulation impairments are associated with adverse outcomes in AUD (Kopera et al., 2014; Berking et al., 2011). Problems with emotion regulation are thought to be the primary motives for alcohol use, as well as a core emotional feature of AUD (Petit et al., 2015). At the same time, Kober (2014) indicate that chronic alcohol use impairs the ability to cope with aversive emotional states given its negative impact on the prefrontal cortex (a key neural region for emotion regulation), which in turn leads to greater alcohol use. Acute alcohol intoxication is considered a secondary emotion regulation mechanism, which increases positive affect and decreases negative affect. One study found that individuals with AUD displayed more difficulties regulating their impulses than HCs in frustrating situations. More specifically, they presented a heightened sensitivity to unfairness in social transactions and responded aggressively (Brevers et al., 2013). This is consistent with the current study where individuals with AUD reported lower emotion regulation competencies compared to HCs even when controlling for negative affect (i.e., depression and anxiety symptoms).

The current study also confirms high rates of alexithymia among individuals with AUD (Thorberg et al., 2009). In the previous studies the rates of alexithymia was recognized in 50% to 78% of individuals with an AUD (Thorberg, Young, Sullivan, & Lyvers, 2009) in comparison to only 10% in the general population (Hirota et al., 2017). Individuals with AUD reported experiencing difficulties identifying and describing their feelings. This indicates that problematic alcohol use may contribute to problems processing intrapersonal emotional signals. Individuals with alexithymia demonstrate an inability to identify, understand, and describe their emotional states, which may contribute to experiencing non-specific and unpleasant arousal. In turn, unpleasant arousal may be especially difficult to regulate among individuals with alexithymia, even among non-addicted samples (Pandey, 2011). Some researchers suggest that individuals with alexithymia may find that the only viable means for effectively coping with unpleasant arousal is engaging in maladaptive behaviors, such as excessive alcohol consumption (Thorberg et al., 2011). It is also plausible that long-term heavy alcohol use further exacerbates alexithymia through its adverse effects on brain structures involved in cognitive regulation of emotional processes, feeding the vicious circle of dependence (Kober, 2014). Although our results support previous findings that individuals with AUD report more severe deficits in recognizing and describing internal emotional states alongside problems in emotion regulation compared to HCs, it will be important that future research examine potential bidirectional effects in greater detail using longitudinal study designs with individuals at risk for AUD. This will help determine whether alexithymia predicts later AUD, whether AUD predicts later alexithymia, or whether both effects are supported over time.

Interpersonal level of emotion processing

Between-group differences in the ability to recognize mental states of others were not found. Yet, individuals with AUD had deficits in recognizing their own emotions. To our knowledge, this is a new finding that needs replication. Prior work indicates that individuals with AUD demonstrate deficits in the accurate labeling of emotions displayed on faces and overestimate the perceived emotional intensity (Castellano et al., 2015). Likewise, there is

strong support for general ToM impairment among individuals with AUD (Onuoha et al., 2016). However, data on the social perceptual component of ToM have been mixed (e.g., Kornreich et al., 2011). The lack of deficits in recognizing the mental states of other people as found in this study may serve the purpose of allowing individuals with AUD to skillfully hide their use from others. One reason for differences across studies is due to heterogeneity observed within individuals with AUD. For example, one study demonstrated that no more than 50% of individuals with AUD had impairments in social perceptual skills. Even though AUD is often related to deficits in mental state perception, there may be subgroups that demonstrate greater deficits (Maurage et al., 2017). Accordingly, it is possible that differences across individuals with AUD and HCs on ToM scales were minimal given the sample composition. Another confounding factor is comorbidity. For example, Thoma and colleagues (2013) observed differences between individuals with AUD and HCs when including patients with comorbid depression, one of the clinical syndromes excluded in the current study. Finally, the relatively low number of ToM studies conducted using individuals with AUD and the low likelihood of studies showing no between-group differences being published may contribute to the lack of previous work demonstrating no differences between individuals with AUD and HCs on ToM domains (Onuoha, 2016).

A potential selection bias in the current study may also explain inconsistencies with prior work. Prior to being admitted to the treatment center, individuals with AUD completed a qualification procedure. Only patients that were able to actively participate in the psychotherapeutic process were admitted (as specified in Materials and Methods section). Thus, individuals with AUD in the current study may possess higher social competencies compared to prior studies. In line with our results, Maurage and colleagues (Maurage et al., 2017) confirmed significant variability in intra- and interpersonal emotional traits within a sample of individuals with AUD. They found that emotional functioning variability in their sample was high with almost 25% of patients reporting no socioemotional deficits. Taken together, the unique composition of the current sample, combined with a limited number of studies assessing ToM among individuals with AUD, may explain discrepancies with prior work.

Limitations

The cross-sectional design of the study precludes any conclusions on the direction of the observed associations. In addition, our study sample included individuals with AUD that voluntarily participated in an inpatient psychotherapeutic program; thus, our findings may not generalize to other individuals with AUD. The control group was comprised of university administrative staff and thus participants across groups were not equally matched on several demographic characteristics (e.g., education). The sample was comprised only of men. Given, that prior work demonstrates that men and women are likely to differ in their intra- and interpersonal skills future work should examine how findings may differ across biological sex. Furthermore, our sample was comprised of Caucasian, Polish individuals, which limits the generalizability of our results to other racial/ethnic groups.

The use of a behavioral measure of an individual's own mental state recognition was not assessed. Yet, there are currently no available objective measures of alexithymia that are able to minimize the social desirability bias inherent in self-report measures.

Clinical Implications

Affective dysregulation is closely related to alcohol treatment outcomes such as relapse, length of stay, and craving intensity (Moos and Moos, 2006). Interventions such as mindfulness-based relapse prevention training (Bowen et al., 2014) or affect regulation training (Stasiewicz et al., 2013), could be added to cognitive-behavioral therapy to enhance its effectiveness. Moreover, if individuals with AUD are able to identify certain emotional deficits, it may motivate them to become involved in psychotherapy. At the same time, it is likely that the lack of genuine behavioral social perception deficits would not hamper the psychotherapy process.

Conclusions

Prior work supports the proposal of general emotional processing deficits in individuals with AUD. Our findings do not confirm this hypothesis. Rather, our results support specific emotional deficits among individuals with AUD. Namely, individuals with AUD do not have problems recognizing emotional and non-emotional facial expressions of other people. They also perceive themselves as equally competent in the recognition of others' emotions as their healthy counterparts. Yet, individuals with AUD perceive themselves as less competent in identifying, describing, and regulating their own emotions. Findings contrast some of the prior work on individuals with AUD, signifying further investigation in this area is needed.

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Table 1

Socio-demographic and clinical characteristics of the individuals with AUD and control participants (HC).

	Individuals with AUD	Healthy Controls	p ^a
Age (years) ^b	44.10 (11.99)	36.76 (13.47)	<0.001
Education (years) ^b	12.09 (2.71)	13.43 (3.28)	0.004
Severity of depressive symptoms ^c	0.92 (0.33–1.67)	0.33 (0–0.50)	<0.001
Severity of anxiety symptoms ^c	0.67 (0.33–1.67)	0.17 (0–0.50)	<0.001
Heavy drinking days in the last 3 months (days) ^c	0 (0–44.00)	3.0 (0–8.50)	0.34
Duration of problematic alcohol use (years) ^b	20.64 (11.13)	-	-
Drinking days in the last 3 months (days) ^c	0 (0–44.50)	8.50 (1.75–19.50)	0.53
Mean abstinence length (days) ^a	41.58 (32.68)	-	-
Alexithymia (%) ^d	49.0	19.8	<0.0001

^a Analysis of variance or Mann-Whitney tests were applied to test differences between alcohol-dependent patients and healthy controls for variables that were either normally distributed or not, respectively.

^b Normally distributed variable described by mean (*SD*).

^c Non-normally distributed variable described by median (interquartile range).

^d Percent of individuals scoring high (>61) on the Toronto Alexithymia Scale