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To cite this article: Cuneyt Evren, Vahap Karabulut, Izgi Alniak, Bilge Evren, Ozlem Helin Carkci, Hanife Yilmaz Cengel, Pelin Ozkara Menekseoglu, Turan Cetin, Muge Bozkurt & Gokhan Umut (2019) Emotion dysregulation and internalizing symptoms affect relationships between ADHD symptoms and borderline personality features among male patients with substance use disorders, *Psychiatry and Clinical Psychopharmacology*, 29:4, 696-706, DOI: [10.1080/24750573.2019.1595271](https://doi.org/10.1080/24750573.2019.1595271)

To link to this article: <https://doi.org/10.1080/24750573.2019.1595271>



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Published online: 20 Mar 2019.



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Emotion dysregulation and internalizing symptoms affect relationships between ADHD symptoms and borderline personality features among male patients with substance use disorders

Cuneyt Evren ^a, Vahap Karabulut^a, Izgi Alniak ^a, Bilge Evren ^b, Ozlem Helin Carkci ^a, Hanife Yilmaz Cengel ^a, Pelin Ozkara Menekseoglu ^a, Turan Cetin^a, Muge Bozkurt ^a and Gokhan Umur ^a

^aResearch, Treatment and Training Center for Alcohol and Substance Dependence (AMATEM), Bakirkoy Training and Research Hospital for Psychiatry Neurology and Neurosurgery, Istanbul, Turkey; ^bDepartment of Psychiatry, Baltalimani State Hospital for Muskuloskeletal Disorders, Istanbul, Turkey

ABSTRACT

OBJECTIVES: The aim of the present study was to evaluate the relationship of borderline personality features (BPFs) with attention-deficit/hyperactivity disorder (ADHD) symptoms among male patients with substance use disorder (SUD) and to evaluate the impact of emotion dysregulation on this relationship. We also wanted to control the effects of depression and state anxiety.

METHOD: Participants included 305 treatment-seeking male patients with SUD. Participants were evaluated by applying the Borderline Personality Inventory (BPI), the Adult ADHD Self-Report Scale (ASRS), the Difficulties in Emotion Regulation Scale (DERS) and the Beck Depression Inventory (BDI), and the Spielberger State-Trait Anxiety Inventory (STAI).

RESULTS: Age, duration of education, marital status, employment status, age at first and age at regular substance use did not differ between those with probable borderline personality disorder (BPD) ($n = 155$, 50.8%) and those without probable BPD ($n = 150$, 49.2%). Probable ADHD risk was 3.5 times higher among those with probable BPD. Also ADHD, DERS, depression and anxiety scores were higher in this group with probable BPD. Scale scores were mild and moderately correlated with each other. In hierarchical regression analysis severity of ADHD symptoms (particularly hyperactivity/impulsivity [HI] dimension), together with difficulties in emotion regulation (particularly impulse control difficulties), depression and trait anxiety predicted the severity of BPFs.

CONCLUSIONS: These findings suggest that the severity of HI symptoms of ADHD is related with the BPFs, while difficulties in emotion regulation, particularly impulse control difficulties, partially mediate this relationship among patients with SUD.

ARTICLE HISTORY

Received 3 January 2019
Accepted 20 February 2019

KEYWORDS

ADHD; anxiety; depression; emotion dysregulation; hyperactivity/impulsivity

Objective

Borderline personality disorder (BPD), which is characterized by a pervasive pattern of instability in affect regulation, impulse control, interpersonal relationships and self-image [1], also may present with chronic feelings of emptiness and fears of being alone or abandoned [2,3]. BPD and substance use disorders (SUDs) are 2 forms of psychological problems that are often diagnosed within the same person [4–9]. BPD is reported to be related to the onset and course of SUDs [5,8]. The link between BPD and SUDs is not surprising because they may also have common etiology; i.e. both BPD [10] and SUDs [11] were shown to be related to childhood trauma. Consistent with this, both have negative emotionality and emotion dysregulation (EDR) and both are impulsive, thus accounting for much of the comorbidity between these disorders [6,7].

Among patients with SUDs, the rate of BPD ranged between 5.2% and 32.0% [6,12,13], with lower levels in

community samples and higher levels in treatment-seeking samples [6]. Rates of SUDs ranged from 14% to 56%, with a median co-occurrence of 52% among patients with BPD at follow-up [14–16]. A recent review suggested that 46.4% of participants with BPD received a current alcohol use disorder (AUD), whereas 39.2% of participants with BPD met criteria for a current drug use disorder (DUD) [7]. Nevertheless, this comorbidity may serve as a negative prognostic factor for both disorders [16]; co-occurrence of SUDs was associated with a greater severity of suicidality in patients with BPD [17], subjects diagnosed with BPD showed a higher rate of comorbid psychopathology [18], and a higher rate of dropouts was found in patients with SUDs [19].

Many clinicians and researchers now advocate for a shift away from the categorical measurement of personality disorders in favour of a more conceptually sound dimensional measurement because they believe

that a categorical diagnostic system is, theoretically and pragmatically, a limited approach [20]. Nevertheless, as well as BPD, the severity of borderline personality features (BPFs) is also related with negative outcomes, social maladjustment and academic underachievement among young adults [21] and contemporary adult disturbance (e.g., self-harming behaviour [SHB], dissociative symptoms, drug use, and relational violence) as well as maltreatment history [22]. Studies conducted among Turkish inpatients with SUDs found that BPFs was related with the history of suicide attempt [23], SHB [24], the severity of chronic anxiety, depression, and alexithymia [25].

Although BPD is usually diagnosed in adults, BPFs can often be traced back to childhood [26] like adult attention-deficit/hyperactivity disorder (ADHD) [27]. Previous study conducted among Turkish university students indicated that depressive symptoms and the severity of ADHD symptoms are the predictors for severity of BPFs [28]. Comorbid ADHD and BPD are characterized by more symptoms of impulsivity, additional psychopathology, comparatively lower intellectual and attentional functioning and increased psychosocial difficulties, including education, substance use and criminal record [29]. Impulsivity, irritability and other symptoms of EDR are characteristically seen in both disorders [30]. In clinical practice, it should be acknowledged that the co-existence of ADHD with BPD may complicate the diagnostic process, and hinder treatment outcomes [31].

ADHD is a childhood-onset disorder that persists into adolescence and adulthood in more than half of the cases [32] and characterized by hyperactivity/impulsivity (HI) and inattention (IN) that negatively impacts one's ability to function and fulfil social and personal obligations [33]. Due to their symptoms, individuals with ADHD may experience more difficulties adapting to new situations and coping with many challenges this life period introduces. Under these circumstances, they may be more vulnerable to using the substance, and to developing SUDs [34,35]. Consistent with this, according to a meta-analysis the prevalence for possible ADHD was 23.1% among individuals with SUDs [36]. Thus, ADHD is a common diagnosis in this population, although, generally there is an under-assessment or under-recognition of ADHD by clinicians among patients with SUDs [37]. Individuals with ADHD and SUDs comorbidity are at greater risk for more negative outcomes [38] and poor treatment outcomes for both SUDs and ADHD [39]. Studies conducted among Turkish patients with AUD found that ADHD was related with alcohol-related problems [40], the severity of alcohol craving [41], SHB (risk was 2.5 times higher) [42], posttraumatic stress disorder [43], and severity of dissociative symptoms [44]. Also, a study conducted among Turkish patients with opioid use disorder (OUD) found that ADHD

was related with the severity of psychopathology (particularly obsessive compulsive dimension) and novelty seeking (particularly trait impulsivity) [45]. Finally, while patients with BPD comorbidity more often diagnosed with comorbid ADHD among patients with SUDs [46], the opposite is also valid [47].

A recent study has suggested that the presentation of ADHD symptoms may change from adolescence to adulthood with less overt HI but ongoing attentional problems, disorganization and symptoms of EDR, like mood swings, temper outbursts and irritability [27], which may all be mistaken with BPFs. Consistent with this Fossati et al. [48] suggested that 60% of adults with BPD meet criteria for childhood ADHD. Ferrer et al. [49] suggested that BPD patients with ADHD comorbidity showed a more homogeneous and impulsive profile while BPD without ADHD comorbidity had more anxiety and depressive disorders. Although many previous studies reported that there is a significant association between ADHD and BPD, the nature of this relation has not yet been completely understood [50–52]. According to a recent review, the association between ADHD symptoms and BPFs is best explained by a partially shared aetiology and vulnerability model [52]. In others words, symptoms of ADHD in childhood may be a risk factor for the later development of BPFs or there is a common aetiology for both of these symptom clusters. Indeed, EDR and impulsivity, in particular, are regarded as a core features of BPD [1,53,54] as it is in adult ADHD [27,54], and SUDs have been conceptualized as disorders of emotional regulation [55–57] and impulsivity [58]. Thus, these may suggest that associations between BPFs and variables such as ADHD symptoms and EDR is an important subject to study, particularly among patients with SUDs.

Emotion regulation refers to the modulation of emotional arousal, the awareness, understanding, and acceptance of emotions, as well as the ability to act in desired ways regardless of emotional state [59]. In recent years, increasing attention has been given to EDR as a potentially common feature of many forms of addiction [55], including chemical addictions such as alcohol [57,60–62], marijuana [63], cocaine [64], and illicit substance use in the past 30 days [65]. Some researchers have argued that individuals who have EDR are more likely to engage in addictive behaviours in an attempt to escape from, or minimize, negative moods and/or try alleviate distressing feelings [66]. A recent studies suggested that higher levels of difficulties regulating positive emotions were found to relate to greater alcohol and drug misuse [67,68]. EDR is a possible mechanism underlying the indirect relationship between negative affectivity and SUDs [69–71] and between early emotional and physical maltreatment and the development of SUDs [72]. Therefore, SUDs have been conceptualized as disorders of emotional regulation [56,57].

EDR is considered a core component in BPD [73], and some authors even consider BPD [74] to be primarily disorders of EDR. The presence of a BPD diagnosis among a sample of SUDs was associated with both higher scores on the self-report measure of EDR and less willingness to tolerate emotional distress on the behavioural measures of EDR [75], whereas EDR fully mediated the relationships between negative affect intensity/reactivity and BPD symptom count in this group of patients [76]. Similarly, according to the previous studies, ADHD is related with EDR [77–80]. In a recent study conducted among Turkish university students, EDR was higher among those with probable ADHD and severity of ADHD symptoms was related with the severity of EDR [81]. EDR of children with ADHD predicted poor long-term clinical and educational outcome in early-adulthood [82]. First, two studies that compared BPD and ADHD according to EDR found significantly higher levels of EDR in the BPD group, compared with the ADHD group [83,84]. A more recent study suggested that adults with ADHD and BPD report comparable difficulties in encouraging oneself to attend inner aversive experiences, without engaging in impulsive behaviour [85]. Finally, mediation analyses revealed that both impulsivity and EDR fully mediated the relationship between retrospectively assessed ADHD symptoms and current BPD features in the female subsample [86]. Nevertheless, evaluation of the relationship between Kernberg's psychodynamic model of personality organization in terms of BPFs and variables such as ADHD and EDR is still limited, particularly among patients with SUDs.

Novelty of the present study is that, although there are some studies that evaluated the relationship of BPFs with ADHD [52] and EDR [75], which also controlled the effects of other related variables on this relationship, this is the first study to evaluate the relationship of BPFs with both ADHD and EDR, particularly among patients with SUDs. Previous studies suggested that as BPFs [25], symptoms of ADHD [34,36] and EDR [69] are also associated with depression and anxiety symptoms among patients with SUDs, which make these related factors highly relevant for clinical practice. We hypothesized that the severity of both ADHD symptoms and EDR may be related with the severity of BPFs even after controlling negative affects such as anxiety and depression. We also wanted to evaluate which dimensions of ADHD and EDR are associated with the severity of BPFs in the present study.

Method

Participants

The study was conducted in Bakirkoy State Hospital for Psychiatric and Neurological Diseases, Alcohol

and Drug Research, Treatment and Training Center (AMATEM) in Istanbul between May 2017 and December 2017; AMATEM is a specialized centre for SUD with 84 inpatient beds and accepts patients from all over Turkey. Patient's written informed consent was obtained after the study protocol was thoroughly explained.

Consecutively admitted 305 male patients (242 inpatients [79.3%] and 63 outpatients [20.7%]) with SUDs were considered for participation in the study.

All participants fit the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition [87] diagnostic criteria for SUD. Among the study sample ($n = 305$), 185 (60.7%) had OUD, 82 (26.9%) had AUD, 29 (9.5%) had synthetic cannabinoid use disorder, 4 (1.3%) had cocaine use disorder, 3 (1.0%) had ecstasy use disorder and 2 (0.7%) had cannabis use disorder. Also, 19 (6.2%) of them had diagnosis of multiple SUDs. Interviews with the study group were conducted after the detoxification period, that is, 3 to 4 weeks after the last day of alcohol or drug use.

Measures

Borderline Personality Inventory (BPI)

BPI mostly focuses on borderline personality organization and is a 53-item self-rated scale [88] based on Kernberg's [89] structural borderline organization. In reliability analyses conducted among Turkish population, Cronbach's alpha of the whole group (40 patients with BPD, 35 patients with major depressive disorder, 30 patients with schizophrenia and 61 healthy subjects) was 0.92, and for the BPD group, it was 0.84. A cut-off point of 15/16 was reported. The Turkish version of BPI, which was found to be reliable and valid, was used in the present study [90]. That is, Cronbach's alpha was 0.92 in the present study.

Adult ADHD Self-Report Scales (ASRS-v1.1)

ADHD symptoms were measured with the ASRS [91], an 18-item scale based on DSM Fourth Edition (DSM-IV-TR) criteria [2]. The 5-point Likert-type scale ranges from "0" (never) to "4" (very often). The Turkish version of ASRS has demonstrated good reliability and validity in university students [92]. Also, in a sample of patients with AUD, psychometric characteristics of Turkish version have been analysed by Evren et al. [93], in which satisfactory properties have been found. Cronbach's alpha was 0.85 for IN, 0.81 for HI and 0.89 for ASRS in the present study.

The ASRS 6-item screen was developed for community based studies and exhibits strong concordance with clinician diagnoses as well as sound psychometric properties [94–96]. We used this screen version to identify highly likely ADHD cases in our sample and named as "probable ADHD." Nevertheless, the result of the test does not replace a clinical diagnosis and

the clinician must take false positives into consideration by evaluating the ASRS positives with gold standard scales.

Difficulties in Emotion Regulation Scale (DERS)

The DERS is a 36-item measure that provides a comprehensive assessment of overall EDR, as well as six specific dimensions: nonacceptance of negative emotions, difficulties engaging in goal-directed behaviours when distressed, difficulties controlling impulsive behaviours when distressed, limited access to effective emotion regulation strategies, lack of emotional awareness, and lack of emotional clarity. The DERS has demonstrated good test-retest reliability and adequate construct and predictive validity [59,97], and is strongly correlated ($r = -0.63$) with an experimental measure of emotion regulation among BPD patients [98]. The Turkish version of the DERS was found to be reliable and valid [99]. In the present study, the DERS total score was used as an index of the overall level of EDR; its Cronbach's α coefficient was 0.93.

Beck Depression Inventory

Depressive symptoms and the severity of depression were evaluated by using the Beck Depression Inventory (BDI) [100], which has been validated on the Turkish population [101]. Cronbach's α was 0.90 for BDI in the present study.

Spielberger State-Trait Anxiety Inventory

As a measure of state and trait anxieties, the Spielberger State-Trait Anxiety Inventory (STAI), a 40-item self-report instrument was used [102]. The Turkish version of the STAI has been shown to have good reliability and validity [103]. Cronbach's α was 0.89 for State and 0.81 for Trait anxiety in the present study.

Statistical analysis

The statistical package SPSS 17.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for all the analyses. Student t test was used to compare groups according to the current age, duration of education and scale scores. Categorical sociodemographic variables were compared by means of the χ^2 statistics. Pearson correlation analyses between scale scores were conducted. Taken the severity of BPFs as a dependent variable, hierarchical (depression, state and trait anxiety scores, ADHD [and dimensions of ADHD] severity and difficulties in emotion regulation [dimensions of EDR]) linear regression models were performed. For all statistical analysis, p values were 2 tailed, and differences were considered significant at $p < .05$.

Results

According to a cut-off point of 15/16 that was reported [88,90], subjects included in the study was grouped as those with probable BPD ($n = 155$, 50.8%) and those without probable BPD ($n = 150$, 49.2%). Age, duration of education, marital status, employment status, age at first substance use and age at regular substance use did not differ between those with probable BPD and those without probable BPD. Probable ADHD risk was 3.5 times higher among those with probable BPD. Also ADHD, DERS, depression and anxiety scores were higher in this group (Table 1).

Scale scores were mild and moderately correlated with each other (Table 2).

Evaluating both zero order and partial correlations among the scales suggested no multicollinearity. Predictors of the severity of BPFs were evaluated in hierarchical linear regression analysis. The severity of depressive and anxiety (both state and trait) symptoms were entered in the analysis as independent variables in the first Step. In the Step 2a severity of ADHD symptoms and in the Step 2b IN and HI (instead of total score of ADHD) were entered in the analysis as independent variables. Finally, in the Step 3a total DERS score and in Step 3b subscales of DERS (instead of total score of DERS) were included in the analysis as independent variables. In this analysis severity of ADHD symptoms (particularly HI dimension), together with difficulties in emotion regulation (particularly impulse control difficulties), depression and trait anxiety predicted the severity of BPFs (Table 3).

Discussion

The main finding of the present study, which is also consistent with our hypothesis, was that the severity of ADHD symptoms (particularly HI symptom dimension of ADHD) and EDR (particularly impulse dimension of DERS) were both related with the severity of BPFs even after controlling negative affects such as depression and anxiety. The findings of the present study may suggest that the difficulties with regard to inhibiting inappropriate or impulse behaviours (impulse control difficulties and HI dimension of ADHD) are related with the severity of BPFs under the effect of negative affect (particularly trait anxiety and depression). The presence of a BPD diagnosis is associated with higher levels of negative affect intensity/reactivity among treatment-seeking SUDs [76]. Chronic efforts to suppress unpleasant thoughts may be a regulation strategy underlying the relationship between intense negative emotions and BPFs [104]. BPD is related with the stress-dependent increase of state impulsivity, whereas response inhibition is particularly impaired in patients with both BPD and ADHD [105]. In a review of Sebastian et al. [106]

Table 1. Comparing sociodemographic variables and scale scores according to the presence of probable borderline personality disorder.

	Probable BPD				<i>T</i>	<i>p</i>
	Absent		Present			
	<i>n</i> = 150, 49.2%		<i>n</i> = 155, 50.8%			
	Mean	S.D.	Mean	S.D.		
Age	33.69	11.34	33.63	10.96	0.048	.962
Duration of education	9.28	3.08	8.84	3.31	1.205	.229
Marital status (<i>n</i> , %)					$\chi^2 = 0.986$.611
Married	48	32.0	55	35.5		
Single	82	54.7	76	49.0		
Divorced/widowed	20	13.3	24	15.5		
Employment (<i>n</i> , %)					$\chi^2 = 5.768$.123
Not working	70	46.7	79	51.0		
Regular job	55	36.7	39	25.2		
Part-time work	16	10.7	26	16.8		
Retired / student	9	6.0	11	7.1		
Age at first substance use	17.01	5.08	16.66	4.40	0.653	.514
Age at regular use	20.14	6.18	19.27	5.50	1.308	.192
ADHD	22.55	9.20	31.72	12.19	−7.436	<.001
Inattentiveness	11.24	5.61	15.21	6.87	−5.546	<.001
Hyperactivity/impulsivity	11.31	5.18	16.50	6.34	−7.851	<.001
Probable ADHD * (<i>n</i> , %)	12	8.0	36	23.2	$\chi^2 = 13.326$	<.001
DERS	83.29	18.55	104.36	19.64	−9.628	<.001
Nonaccept	13.88	4.79	17.10	5.28	−5.577	<.001
Goals	13.23	4.23	16.47	3.77	−7.082	<.001
Impulse	13.35	4.25	17.24	4.56	−7.707	<.001
Awareness	15.31	3.91	17.27	3.97	−4.352	<.001
Strategies	16.90	5.77	22.88	5.61	−9.187	<.001
Clarity	10.63	3.29	13.39	3.59	−7.006	<.001
Depression	11.81	7.96	21.35	11.51	−8.444	<.001
State Anxiety	35.71	10.00	42.61	9.85	−6.070	<.001
Trait Anxiety	42.33	7.86	49.47	8.13	−7.789	<.001

Notes: BPD: Borderline personality disorder; ADHD: attention-deficit/hyperactivity disorder; DEERS: Difficulties in Emotion Regulation Scale; *Odds Ratio (95% Confidence Interval) = 3.479 (1.731 – 6.991).

evaluating the role of ADHD concerning impulsivity in BPD, suggested that high impulsivity might be especially present in the comorbid group of patients suffering from both ADHD and BPD. Unfortunately, this study was not designed for evaluating the causal relationship of BPFs with other variables evaluated in the present study. Also, we did not evaluate impulsivity directly, which may be considered as one of the limitations of the present study. Nevertheless, impulse control difficulties of EDR and HI dimension of ADHD predicted the severity of BPFs in the present study.

Although our previous study conducted among Turkish patients with OUD suggested that probable ADHD was related with the severity of psychopathology (particularly obsessive compulsive dimension)

and novelty seeking (particularly trait impulsivity) rather than the presence of BPD [107], the present study evaluated the severity of these disorders, rather than the presence of them. Also, the previous study reported that although patients with BPD comorbidity more often diagnosed with comorbid ADHD among patients with SUDs, this risk was higher among those with AUD (OR = 7.0, 95% CI = 3.1–15.6) than those with DUD (OR = 3.4, 95% CI = 1.8–6.4) [47]. Thus, the relationship between BPFs and ADHD symptoms may change when more homogeneous group of patients with OUD is considered.

“Emotion regulation” refers to the strategies used to influence, experience, and modulate emotions and may include dynamics such as suppression and/or cognitive re-appraisal of a stressful situation [108]. EDR is conceptualized as one of the core components of SUDs [56,57]. EDR is a possible mechanism underlying the indirect relationship between negative affectivity and greater alcohol and drug misuse [68,69], alcohol-related problems [71], craving for alcohol [62,70] and the maintenance of alcohol use [62]. Previous studies suggest that the period of early abstinence is particularly related with EDR [61,64]. A study conducted among cocaine-dependent individuals suggested that compared with controls, they have difficulties relating to understanding emotions, managing emotions and impulse control in the first week of abstinence [64]. Consistent with this, study comparing social drinkers

Table 2. Correlation coefficients between scale scores.

	ASRS	IN	HI	BPI
BPI	0.496	0.423	0.479	
BDI	0.348	0.309	0.323	0.543
STAI State	0.303	0.263	0.288	0.446
STAI Trait	0.451	0.433	0.386	0.539
DEERS	0.592	0.546	0.528	0.554
Nonaccept	0.348	0.310	0.322	0.329
Goals	0.538	0.502	0.475	0.475
Impulse	0.521	0.462	0.484	0.489
Aware	0.266	0.280	0.201	0.288
Strategies	0.550	0.484	0.515	0.507
Clarity	0.438	0.442	0.353	0.409

Notes: For all coefficients $p < .001$, ASRS: Adult ADHD Self-Report Scale; IN: Inattentiveness; HI: hyperactivity/impulsivity; BPI: Borderline Personality Inventory; BDI: Beck Depression Inventory; STAI: Spielberger State-Trait Anxiety Inventory; DEERS: Difficulties in Emotion Regulation Scale.

Table 3. Hierarchical linear regression analysis where severity of borderline personality features are taken as dependent variable and depression, state and trait anxiety scores, ADHD (and dimensions of ADHD) severity and difficulties in emotion regulation are taken as independent variables.

Model	Unstandardized coefficients		Standardized coefficients		<i>t</i>	<i>P</i>
	<i>B</i>	Std. error	Beta			
Step 1	Depression	0.339	0.057	0.343	5.962	<.001
	Trait anxiety	0.413	0.072	0.332	5.774	<.001
Step 2a	Depression	0.305	0.054	0.309	5.626	<.001
	Trait anxiety	0.277	0.072	0.223	3.861	<.001
	ASRS score	0.267	0.045	0.288	5.882	<.001
Step 2b	Depression	0.299	0.054	0.302	5.521	<.001
	Trait anxiety	0.288	0.072	0.231	4.012	<.001
	IN score	0.113	0.098	0.068	1.153	.250
	HI score	0.426	0.099	0.248	4.281	<.001
Step 3a	Depression	0.268	0.055	0.270	4.901	<.001
	Trait anxiety	0.208	0.076	0.167	2.744	.006
	IN score	0.049	0.099	0.030	0.497	.619
	HI score	0.364	0.101	0.212	3.617	<.001
	DERS score	0.091	0.031	0.182	2.916	.004
Step 3b	Depression	0.277	0.054	0.280	5.113	<.001
	Trait anxiety	0.241	0.073	0.194	3.324	.001
	IN score	0.073	0.097	0.044	0.745	.457
	HI score	0.360	0.101	0.210	3.574	<.001
	Impulse of DERS	0.353	0.122	0.156	2.903	.004

Notes: ASRS: Adult ADHD Self-Report Scale; IN: Inattentiveness; HI: Hyperactivity/impulsivity; DERS: Difficulties in Emotion Regulation Scale. Step 1: $F = 86.858$, $df: 2, 302$, $p < .001$, Adjusted $R^2 = .293$; Step 2a: $F = 75.878$, $df: 3, 301$, $p < .001$, Adjusted $R^2 = .361$, R^2 Change = .070; Step 2b: $F = 58.125$, $df: 4, 300$, $p < .001$, Adjusted $R^2 = 0.429$, R^2 Change = 0.071; Step 3a: $F = 49.364$, $df: 5, 299$, $p < .001$, Adjusted $R^2 = 0.443$, R^2 Change = 0.016; Step 3b: $F = 49.336$, $df: 5, 299$, $p < .001$, Adjusted $R^2 = 0.443$, R^2 Change = .015.

with patients with AUD reported significant differences in emotional awareness and impulse control during week 1 of treatment [61]. Although abstinence is associated with a shift toward more adaptive emotion regulation patterns in patients with AUD [61,62] and cocaine use disorder [64], significant difficulties with impulse control persisted with continued abstinence in these patients [61,64]. Authors of these studies suggested that protracted stress-related impulse control problems in patients with SUDs may contribute to increased relapse vulnerability [61,64]. Impulse control represents one of the major behavioural elements of emotion regulation [59] and impulsivity has been identified in a large number of studies as an important component of addictive processes [61,64,109,110]. Impulse refers to impulse control difficulties, in other words problems controlling one's own behaviour, when experiencing intense negative emotions [111]. Difficulties applying coping strategies and avoiding impulsive behaviour at times of emotional distress indicate decrements in emotional flexibility, and may reflect a change in priority from self-control to affect regulation [112]. Findings of the present study are also consistent with previous research indicating that impulse control disorders are more common in patients with SUDs [58,61,64,113].

Findings of the present study imply susceptibility to impulsive behaviours such as substance use, lapses in judgment, poor decision-making and an inability to control impulses during stress. Protracted distress-related impulse control problems suggest potential relapse vulnerability among patients with SUDs [61,64]. Thus, it is important to develop treatment strategies focusing specifically on distress regulation and

impulse control difficulties [64]. Results of a systematic review demonstrated that regardless of the intervention or disorder, significant decreases were found not only in symptoms of anxiety, depression, substance use and BPD, following a psychological intervention for these disorders but also for maladaptive emotion regulation strategy use and overall EDR [114]. A potential benefit in a subpopulation of individuals with co-occurring ADHD and BPD may be a reduction in EDR and impulsivity following medication treatment of ADHD [31]. Although methylphenidate may be useful and well tolerated in treating some shared symptoms of ADHD and BPD among female adolescents [115] and led to significant improvements in EDR possibly owing, in part, to a decrease in impulsivity, so that individuals felt more able to supervise their emotions and engage in goal-directed behaviours among adolescents with ADHD [116], adjunctive nonpharmacologic modalities may be especially helpful in the case of comorbid ADHD, depression, anxiety, SUDs, or BPFs [117]. Training of emotion regulations has been included as an important component of various therapeutic approaches, such as emotion focused therapy [118], acceptance- and mindfulness- based therapy [119], and emotion regulation therapy [55].

The present study also has some limitations. First, because this study is cross-sectional, its findings cannot indicate the causal relationships among the primary constructs of interest. Second, female patients may have a different profile concerning BPFs, ADHD, EDR, anxiety and depression. Consistent with this EDR mediated the relationship between ADHD symptoms and BPFs only in the female subsample in previous study [86]. Although BPD is more common in

females, unfortunately most of the treatment-seeking patients with SUD are males. Thus, according to the aim of the present study it was inevitable to conduct among male patients. Nevertheless future studies are needed to evaluate same issue among female patients. Third, it is important to note that the assessments were conducted over the initial few weeks of abstinence, and it is possible that the pattern of improved emotion regulation would have continued with sustained abstinence [61,64]. Fourth, although all the scales used in the present study were validated in Turkish, since they are self-rating screening scales, they may only indicate the individuals with a high severity of psychopathology, rather than the diagnosis. Fifth, we did not screen for impulsivity or common comorbidities such as impulse control disorders, which may be considered as a limitation. Because, as EDR [54,67], impulsivity is also regarded as an important feature of BPD [1,53,54], adult ADHD [27,54], and SUDs [58,67]. Similarly, we did not evaluate childhood trauma, which can be considered as a common etiological factor for the subjects of interest. Consistent with this, a previous study suggested a strong association between impulsivity, childhood trauma, dissociation, and ADHD symptoms in patients with BPD [120]. Finally, the generalizability of the findings of the present study to the wider, non-treatment-seeking, mixed-sex population with SUDs requires further study.

Despite these limitations, this is the first study directly to evaluate the relationship between adult symptoms of ADHD and BPFs, while also considering other variables such as EDR, depressive and anxiety symptoms. The results of the present study match up with our hypothesis that besides trait anxiety and depressive symptoms, the severity of symptoms of adult ADHD and also EDR predicted the severity of BPFs. Therefore, at least, findings of the present study suggest that clinicians must carefully evaluate these variables in patients with SUDs, since those with severe symptoms of HI in adulthood, together with impulse control dysregulation of emotion, may also be candidates for severe BPFs. Moreover, depressive symptoms and trait anxiety should be taken into consideration, since they have an effect on these relationships. In clinical and non-clinical populations, further, follow-up studies need to be done to evaluate the causal relationship between these variables.

ORCID

Cuneyt Evren  <http://orcid.org/0000-0002-4431-3514>
 Izgi Alniak  <http://orcid.org/0000-0002-9992-104X>
 Bilge Evren  <http://orcid.org/0000-0003-4934-662X>
 Ozlem Helin Carkci  <http://orcid.org/0000-0001-7538-8685>
 Hanife Yilmaz Cengel  <http://orcid.org/0000-0001-7589-2320>
 Pelin Ozkara Menekseoglu  <http://orcid.org/0000-0002-9954-3544>

Muge Bozkurt  <http://orcid.org/0000-0001-8300-0943>

Gokhan Umut  <http://orcid.org/0000-0002-2614-6812>

Disclosure statement

No potential conflict of interest was reported by the authors.

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