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ORIGINAL ARTICLE

Difficulties with emotion regulation, mindfulness, and substance use disorder severity: the mediating role of self-regulation of attention and acceptance attitudes

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ABSTRACT

Background: Theoretical frameworks postulate that mindfulness represents a relevant therapeutic process in substance use disorders (SUDs), especially in treating difficulties with emotion regulation (DER). Nonetheless, it remains unclear how mindfulness dimensions, particularly self-regulation of attention and acceptance attitudes, are implicated in the well-validated relationship between DER and SUDs. It is also uncertain whether mindfulness is considered a common protective factor for SUDs. *Objectives*: To investigate the mediating role of mindfulness in the relationships between DER and SUDs among treatment-seeking patients with alcohol use disorder (AUD). *Methods*: Two related domains of mindfulness were evaluated: (a) self-regulation of attention (Mindful Attention Awareness Scale, MAAS) and (b) acceptance attitudes (Five Facet Mindfulness Questionnaire, FFMQ, nonjudging, and nonreactivity subscales)). Two-hundred and forty-four (149 males and 95 females) participants with AUD were assessed. Mindfulness, DER, and SUD severity (alcohol, benzodiazepines, and other drugs) were assessed after a 2-week detoxification period. Three independent multiple parallel mediational models, controlling for the heterogeneity of sample characteristics, were proposed. *Results*: MAAS and FFMQ nonjudging were significant mediators of the relationship between DER and AUD severity. Mindfulness dimensions and DER were not related to other drug use disorders. DER represented a relevant factor in explaining the severity of benzodiazepine use disorder, although mindfulness was not significantly related to it. *Conclusion*: Mindfulness appears to be a protective factor for DER effects on AUD. Future research should evaluate additional dysfunctional processes to clarify how unique dimensions are implicated in the development and maintenance of different SUDs.

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Substance use disorders; mindfulness; emotion regulation; self-regulation of attention; nonjudging; nonreactivity

Introduction

Negative affectivity and difficulties with emotion regulation (DER) are widely considered relevant risk factors for the development and maintenance of substance use disorders (SUDs) (1–3). Particularly, several empirical studies have demonstrated that SUD patients show impairments in emotional awareness and clarity (4,5), difficulties with impulse control while experiencing negative emotions (4,5), and deficits in accepting and tolerating negative emotions (6,7). It was also revealed that SUD individuals frequently use dysfunctional emotion regulation strategies, such as suppression (8,9). Furthermore, individual differences in negative affectivity have been repeatedly associated with craving, substance use, and relapse in clinical and laboratory studies (e.g. 10–13). Consistent with the previous evidences, several relapse prevention treatments for SUDs target DER in order to support long-term abstinence (2). Specifically, mindfulness-based interventions (MBIs) have demonstrated efficacy in maintaining abstinence (14,15) and in addressing negative affectivity among SUD patients (16).

Independently of theoretical and clinical approaches, several scholars (e.g. 17, 18) recognized two common mechanisms that are implicated in operationalizing mindfulness construct, and in explaining how mindfulness might sustain therapeutic changes: (a) the self-regulation of attention (i.e. focused attention and open monitoring) and (b) acceptance attitudes (i.e. nonjudgment, nonreactivity) related to present-moment experiences. Likewise, reviewing overlapping neuroscience data from addiction and mindfulness research, Witkiewitz and colleagues (19) sustained that mindfulness practices by improving attention regulation, acceptance, and nonjudgmental attitudes toward emotional and craving experiences might influence both top-down (e.g. inhibitory control, conflict monitoring) and bottom-up (e.g. reactivity of stress response

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system) processes relevant to addiction mechanisms. Similarly, Brewer and colleagues (20) provided a theoretical background to hypothesize how mindfulness could sustain therapeutic changes in SUDs. In detail, improving the self-regulation of attention might reduce the negative emotionality associated with ruminative thought patterns and the tendency to suppress thoughts, both of which have been associated with craving and relapse in addictive behaviors (21,22). Moreover, the development of an attitude of acceptance (i.e. a nonjudging/nonattached view of experiences) could reduce negativity affectivity by reinforcing distress tolerance abilities in relation to several experiences (e.g. craving, stress, anxiety), which have been linked to treatment outcomes (e.g. 23).

Interestingly, a meta-analytic review conducted by Karyadi and colleagues (24) preliminarily supported the previous hypotheses. In particular, they have demonstrated significant and negative relationships between attentional (i.e. acting with awareness) and acceptance (i.e. nonjudging, nonreactivity) mindfulness traits with alcohol and tobacco use behaviors among clinical and nonclinical individuals. However, these previously observed associations have not been replicated for other drug use, such as marijuana. Research (25) has also suggested that, similar to addiction mechanisms, attentional and acceptance mindfulness dimensions might sustain several adaptive emotion regulation strategies (e.g. 26–28) and could be considered protective factors for other dysfunctional emotional-based processes, such as experiential avoidance (29), thought suppression (30), worry (31), and rumination (32), also associated with SUDs (33–37). Overall, mindfulness seems to represent a relevant protective factor for the core clinical targets (e.g. craving, negative affectivity) of SUDs. Moreover, mindfulness-related mechanisms might be considered adaptive processes implicated in reducing DER among SUD individuals. Nonetheless, although theoretical backgrounds have been provided, no empirical studies have evaluated the role of self-regulation of attention and acceptance dimensions associated with mindfulness in explaining how DER contribute to the severity of SUDs.

However, with regard to a reliable self-report assessment of the previous mindfulness dimensions, some considerations need to be discussed. Specifically, quantitative psychology has conceptualized them within uni- (38,39) or multidimensional (e.g. (40)) mindfulness operationalizations. Respectively, the most widely used and validated mindfulness questionnaires refer to the Mindful Attention Awareness Scale (MAAS (38,41–43)) and the Five Facet Mindfulness Questionnaire (FFMQ (44–47)). In particular, according to Bergomi and colleagues' suggestions (48), the MAAS appears to address both attentional processes and acceptance dimensions but does not differentiate one aspect from the other and seems to be mainly related to the neurocognitive function of sustained attention (49–52). Additionally, acceptance is considered a substantial second-order feature of the ability to sustain attention (53). Conversely, the FFMQ is largely considered a comprehensive conceptualization of mindfulness, which demonstrated a multifaceted construct composed of specific psychological and behavioral skills (i.e. observing, describing, acting with awareness, being nonreactive, and being nonjudging). However, it also has some limitations, primarily in the evaluation of attentional processes related to the construct (44,54). Consequently, although the use of self-report instruments has been called into question (e.g. 17), the combined administration of the previous questionnaires could be a feasible solution in order to effectively assess both attentional processes and acceptance dimensions related to mindfulness.

As a result, considering the clinical relevance of mindfulness-related processes as common protective factors for DER and SUDs (24–37), as well as for explaining how DER are implicated in SUDs (19,20), the current research aims to empirically clarify whether self-regulation of attention and acceptance attitudes might represent factors mediating the relationship between DER and the severity of several SUDs among treatment-seeking patients with alcohol use disorder (AUD). Given the unique advantages and disadvantages previously discussed in relation to the most widely used mindfulness assessment instruments, we considered MAAS scores to be a reliable self-report index of self-regulation of attention associated with the mindfulness construct. Moreover, to effectively capture the multifaceted nature of the mindfulness acceptance dimension, which is characterized by both the ability to take a nonevaluative stance toward experiences (55) and the ability to view psychological events as transient phenomena without reacting to them (56,57), we referred to the FFMQ nonjudging and nonreactivity subscales, respectively. Additionally, taking into consideration the moderating role of the type of substance use (i.e. alcohol vs. other drugs) in the strength of associations between substance use behaviors and mindfulness (24), we separately tested mediational models for the severity of each SUD (i.e. alcohol, benzodiazepines, and other drugs) revealed in our sample. Consistent with Karyadi and colleagues' findings, we hypothesized that we would exclusively observe a mediating role of mindfulness, considering both the self-regulation of attention and acceptance dimensions, in relation to the severity AUD but not for the other

SUDs. In particular, we assumed a positive indirect effect representing a protective factor for mindfulness, considering how DER contributes to AUD severity. As a result, we also preliminarily postulated that the implementation of acceptance attitude and self-regulation of attention in clinical practice should be considered a relevant therapeutic goal in order to effectively address DER in AUD. Conversely, for other SUDs, it is necessary to hypothesize alternative mechanisms and approaches to treat core clinical targets.

Methods

Participants

From January 2012 to June 2015, we consecutively admitted a voluntary sample of 244 treatment-seeking individuals with AUD (according to DSM-IV-TR criteria). Participants were recruited from the Alcohol Dependence Treatment Unit, which provides in- and outpatient treatments completely covered by the National Health Care System. Specifically, the facility provides detoxification (2 weeks) and rehab (2 weeks) interventions for a total of 1 month of hospitalization. The rehab intervention, which is carried out after the detoxification period, is based on an adaptation of Dialectical Behavior Therapy Skills Training (DBT-ST) for SUDs. The outpatient program lasts 3 months and is based on DBT-ST. Participants who are hospitalized can be admitted to the outpatient intervention in order to complete the DBT-ST program (for a detailed description of the treatment structure, see 58)

The sample was composed of both male (61.1%) and female (38.9%) subjects between the ages of 21 and 71 (Mean (SD) = 47.14 (9.14)). Educational levels were equally distributed among participants (27.5% middle school graduates; 25% vocational training; 22.5% high school graduates; 23.4% university degree).

Subjects with psychotic disorders and severe cognitive impairment were excluded in order to control for possible biases in self-report assessments induced by such clinical conditions. Given the well-documented comorbidities between alcohol dependence and other psychiatric disorders/SUDs (e.g. (59,60)), the exclusion criteria did not include lifetime codiagnoses of other Axis I disorders, except when symptomatology showed that the disorders were in an active phase during the preliminary psychiatric clinical evaluation and additional SUDs. Table 1 shows a detailed description of the comorbid conditions in our sample.

Procedure

This study was consistent with the code of conduct for research in psychology (Associazione Italiana di Psicologia: Codice Etico per la Ricerca in Psicologia) (61) in line with the ethical principles of the American Psychological Association (APA) (62), and it was approved by the Ethics Committee of our hospital. All participants provided informed consent prior to participation in the study.

Before the participants' admission to treatment provided by our hospital, two senior psychiatrists conducted unstructured clinical interviews based on DSM-IV-TR criteria (63) to confirm the diagnosis of AUD and to evaluate the presence of other psychiatric disorders in order to identify exclusion criteria.

Considering possible threats to the reliability of self-report results in addiction research (64,65) as well as the well-documented effects of substance intoxication and withdrawal symptoms on emotional and cognitive functioning (66), we decided to administer assessment instruments after a 2-week detoxification period conducted in inpatient (79%) and outpatient (21%) format in order to ensure the reliability of our findings. Abstinence was confirmed by daily urine toxicology screening (ethyl glucuronide, ethyl glucuronide/creatinine, metabolites of cannabinoids, cocaine, amphetamines, opioids, and benzodiazepines).

Assessment instruments

Difficulties in Emotion Regulation Scale (*DERS* (67)): the DERS is a 36-item self-report questionnaire with items rated on a 5-point Likert scale. The DERS

Table 1. Distributions of current SUD codiagnoses and lifetime axis I codiagnoses, comparing men with women (N = 244).

	N	% total sample	Men (N = 149) N (%)	Women (N = 95) N (%)	χ^2 (1)
Poly-drugs users	103	42.2	61 (40.9%)	42 (44.2)	.32
Cannabis use disorder	32	13.1	25 (16.7%)	7 (7.3%)	9.21**
Cocaine use disorder	32	13.1	25 (16.7%)	7 (7.3%)	9.21**
Cannabis use disorder + cocaine use disorder	15	6.1	13 (8.7%)	2 (2.1%)	6.03*
Anxiolytic use disorder	75	30.7	38 (25.5%)	37 (38.9%)	8.80**
Affective disorders	24	10	7 (4.7%)	17 (17.8%)	9.19**
Anxiety disorders	24	10	9 (6.0%)	15 (15.7%)	6.03*
Eating disorders	2	.8	0 (0.0%)	2 (2.1%)	1.76
Gambling disorder	7	2.8	7 (4.7%)	0 (0.0)	3.59

**$p < .01$; * $p < .05$.

consists of six subscales—nonacceptance (e.g. "when I'm upset, I feel ashamed at myself for feeling that way"), goals (e.g. "when I'm upset, I have difficulty focusing on other things"), impulse (e.g. "when I'm upset, I lose control over my behaviors), awareness (e.g. "I pay attention to how I feel"), strategies (e.g. "when I'm upset, I believe that wallowing in it is all I can do"), and clarity (e.g. "I have no idea how I am feeling"). The higher the total score is, the higher the level of emotional dysregulation. The original version showed good psychometric indexes (DERS total score: $\alpha = .93$; DERS subscales: $\alpha \geq .80$). We administered the Italian version of the DERS; an Italian validation study (68) showed adequate psychometric properties (DERS total score: $\alpha = .92$; DERS subscales: $.77 \geq \alpha \geq .89$). In our sample, the DERS total score ($\alpha = .88$) and its subscales ($70 \geq \alpha \geq .80$) demonstrated good internal consistency. For the purposes of this study, we considered the DERS total score.

Mindful Attention Awareness Scale (*MAAS* (38)): the MAAS is a 15-item self-report questionnaire in which items are rated on a 6-point Likert scale. The total score reflects the mean score of each MAAS item (e.g., "I find myself doing things without paying attention," reverse score). The higher the MAAS score is, the higher the subject's mindfulness level. The scale demonstrated good internal consistency in the original work ($\alpha = .82$) and in further psychometric validations (e.g. (21)). The MAAS Italian version was administered; the Italian validation study replicated the original psychometric properties ($\alpha = .84$) (69). In our sample, the MAAS showed high internal consistency ($\alpha = .87$).

MAAS is a self-report 15-item questionnaire. Items are rated on a 6-point Likert type scale, ranging from 1 (almost always)to6(almost never)

Five Facet Mindfulness Questionnaire (*FFMQ* (44)): the FFMQ is a 39-item self-report questionnaire with items rated on a 5-point Likert scale. As previously mentioned, the FFMQ conceptualizes mindfulness considering five dimensions—observing (e.g., "I pay attention to sensations, such as the wind in my hair or the sun on my face"), describing (e.g., "I am good at finding words to describe my feelings"), acting with awareness (e.g. "When I do things, my mind wanders off and I'm easily distracted," reverse score), nonjudging (e.g. "I criticize myself for having irrational or inappropriate emotions," reverse score), and nonreacting (e.g. "I perceive my feelings and emotions without having to react to them"). In the original validation study, Cronbach's alphas ranged from 0.75 to 0.91 for all scales, except for the nonreactivity subscale ($\alpha = .67$). The scale demonstrated good psychometric proprieties in further validation studies (45–47). We used the Italian version of the FFMQ; the Italian validation (70) showed high internal consistency for the total score ($\alpha = .86$) and acceptable values for the subscales ($\alpha \geq .75$). In our sample, we found similar internal consistency indexes (total score: $\alpha = .75$; nonjudging subscale: $\alpha = .77$; nonreactivity subscale: $\alpha = .75$). Consistent with the study aims, we used the FFMQ nonjudging and nonreactivity subscales.

Shorter PROMIS Questionnaire (*SPQ* (71)): The SPQ is a 160-item self-report instrument for simultaneous assessment of multiple addictive behaviors (16 scales with 10 items each). Items are rated on a 6-point Likert scale, and the scale items each reflected seven common characteristics of addictive behavior (72): preoccupation, use alone, use for effect, use as a medicine, protection of supply, using more than planned, and increased capacity or tolerance. Consistent with the scope of the current work, we considered alcohol, prescription, and other drugs subscales. The previous subscales demonstrated high internal consistency in the original work ($.94 \geq \alpha \geq .98$) and in further validation research (e.g. (73)). We administered an Italian adaptation of SPQ; this version of the SPQ was translated into Italian by a clinical psychologist fluent in English who was blind to the study hypotheses. This translation was also checked through back-translation by a native English-speaking translator. In accordance with the temporal DSM-IV-TR criteria for SUDs, we asked the participants to answer the SPQ questions by referring to the last 12 months before the detoxification period. Our Italian adaptation demonstrated adequate Cronbach's alphas values, especially for the alcohol, prescription, and other drug subscales ($.85 \geq \alpha \geq .96$).

Statistical analyses

SPSS 22 (IBM, USA)was used to analyze data. The Kolmogorov-Smirnov test was conducted to demonstrate the normal distribution of variables in our sample. In line with the notable differences in SUDs and comorbid conditions among males and females, the χ^2 index and *t*-test were conducted to evaluate codiagnosis distributions and levels of variables included in the mediational models among both groups. The *t*-test was also used to estimate the effect of poly-drug use on the variables considered for mediational analysis.

Consistent with study hypotheses regarding the role of mindfulness dimensions in explaining how DER contributes to SUD severity, we proposed mediational analyses (74). Considering the multi-faceted nature of mindfulness mechanisms (17,18, 52–54), multiple parallel mediational models were computed using the PROCESS tool for SPSS (74). Model 4 was used to

estimate statistics. In line with the study hypotheses, we proposed mediational analyses for each substance category (i.e. alcohol, prescription, and other drugs), for a total of three independent models, considering the DERS total score as an independent variable, SPQ subscales as dependent variables, and mindfulness dimensions (i.e., MAAS total score, FFMQ nonjudging, FFMQ nonreacting) as parallel mediators of the previous relationships. Multicollinearity was tested concurrently considering DERS, MAAS, and FFMQ scores in order to control possible confounding effects of interrelationships among independent and mediator variables. We applied criteria proposed by Bowerman and O'Connell (75), Myers (76), and Menard (77) to evaluate the presence of collinearity problems. Consistent with the procedures proposed by Hayes (74) to test mediation, we computed: (a) the direct effect (*c'*) (i.e. the DERS total score with estimated SPQ subscales, controlling for the effect of the mediators); (b) coefficient *a* (i.e. the DERS total scores with the estimated MAAS total score and FFMQ subscales); (c) coefficient *b* (i.e. the MAAS total score and FFMQ subscales with estimated SPQ subscales, controlling for the DERS total score); (d) indirect effects (*ab*) (total and for each mindfulness dimension); and (e) the total effect ($c = c' + \Sigma\ ab$). Bias-corrected bootstrap methodology using 1000 independent samples (95% confidence interval, CI) and the Sobel test were applied to estimate the significance of the indirect effect. The bootstrap 95% CI was also computed to evaluate the significance of the direct, total effect, and regression parameters. Finally, given the possible confounding effects of the heterogeneity of sample characteristics (78–80), poly-drug use, sex, age of onset of AUD, and years of illness were simultaneously considered as covariates within each mediational model. Moreover, taking into account the high co-occurrence between SUDs observed in our sample, results were also simultaneously controlled for the severity of each SUD by introducing SPQ subscales as covariates within each mediational model.

Results

Table 1 describes the distribution of comorbid conditions among the recruited sample and by sex. Table 2 shows descriptive statistics for the self-report instruments and Kolmogorov-Smirnov test values. The variables were normally distributed in our sample. We excluded multicollinearity problems. Particularly, we did not observe tolerance values below .2 (77) (.62 ≤ tolerance ≤ .90), no variance inflation factor (VIF) values were greater than 10 (75,76) (1.10 ≤ VIF ≤ 1.60), and the average VIF was close to 1 (75) (average VIF = 1.36).

The mediating role of mindfulness in alcohol use disorder severity

Figure 1 shows a detailed description of the parameter estimation. Overall, we found a significant total indirect effect (ab_{total} = .06 [.01–.12]; Z = 2.22; $p < .05$) of mindfulness dimensions on the relationship between DER and AUD severity. In particular, self-regulation of attention (ab_1 = .003 [.0004 –.007]; Z = 2.06; $p < .05$) and a nonevaluative stance toward experiences (ab_2 = .02 [.003–.05]; Z = 2.09; $p < .05$) showed significant indirect effects on the relationship previously mentioned. Conversely, we could not replicate these findings considering levels of nonreacting from the FFMQ (ab_3 = −.006 [−.03–.02]; Z = −.60; *ns*). The

Table 2. Descriptive statistics of self-report assessment, kolmogorov-smirnov test, *t*-test results comparing both patients who met criteria only for AUD with poly-drugs users, and men with women.

	Total sample (*N* = 244) *M* (SD)	Total sample (*N* = 244) K-S values	Only AUD (*N* = 141) *M* (SD)	PDsUs (*N* = 103) M (SD)	AUD vs PDsUs *t*(242)	Men (*N* = 149) *M* (SD)	Women (*N* = 95) *M* (SD)	Men vs Women *t*(242)
SPQ alcohol	29.11 (12.67)	.05	29.41 (12.61)	28.94 (12.66)	.18	29.53 (12.55)	28.45 (12.90)	.65
SPQ illegal drugs	9.81 (4.15)	.06	4.00 (2.15)	15.62 (6.16)	−6.68***	10.91 (5.20)	5.72 (3.01)	2.85**
SPQ prescription drugs	14.52 (6.33)	.06	8.15 (3.52)	20.90 (9.14)	−8.37***	11.80 (8.03)	16.18 (4.61)	−2.53**
DERS total score	105.61 (24.68)	.04	101.61 (25.80)	110.80 (22.00)	−2.82**	103.21 (22.68)	109.34 (27.22)	−1.90
MAAS total score	3.69 (.92)	.03	3.86 (.90)	3.46 (.91)	3.25**	3.66 (.93)	3.74 (.92)	−.66
FFMQ nonreactivity	20.00 (4.97)	.06	20.69 (5.06)	19.08 (4.73)	2.49*	20.48 (4.93)	19.25 (4.95)	1.89
FFMQ nonjudging	23.73 (6.12)	.05	23.90 (6.05)	23.47 (6.25)	.57	23.42 (6.04)	24.21 (6.24)	−.97

***$p < .001$; **$p < .01$; *$p < .05$. AUD = Alcohol Use Disorder; DERS = Difficulties with Emotion Regulation Scale; FFMQ = Five Facet Mindfulness Questionnaire; K-S = Kolmogorov-Smirnov test; MAAS = Mindful Attention Awareness Scale; PDsUs = Poly-Drugs Users; SPQ = Shorter PROMIS Questionnaire.

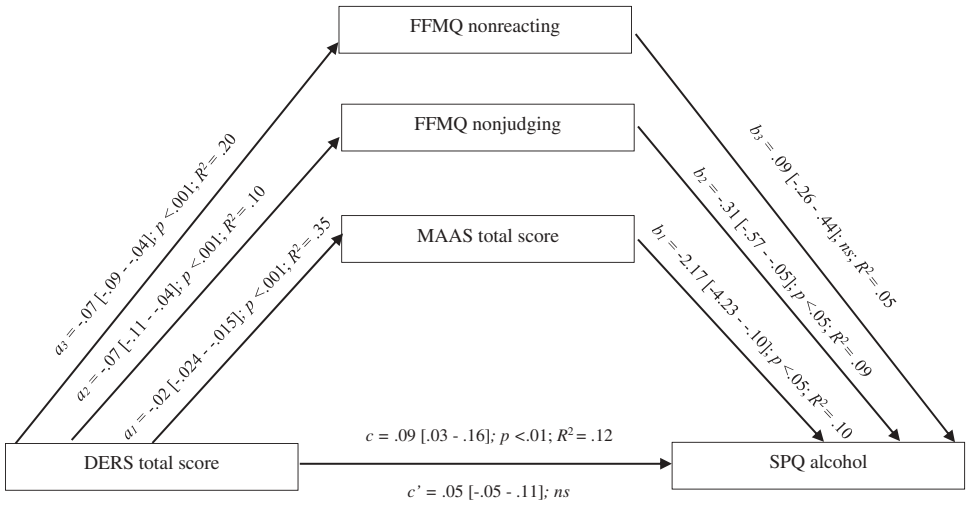

Figure 1. The mediating role of self-regulation of attention and acceptance attitudes on alcohol use disorder severity (N = 244). DERS = Difficulties with Emotion Regulation Scale; FFMQ = Five Facet Mindfulness Questionnaire; MAAS = Mindful Attention Awareness Scale; SPQ = Shorter PROMIS Questionnaire.

direct effect of the DERS total score on SPQ alcohol levels was not significant (c' = .03 [−.05–.11]; *ns*). Finally, we observed a significant total effect of DER on AUD severity (c = .09 [.03–.16]; p < .001; R^2 = .12).

The mediating role of mindfulness in other drugs use disorder severity

Mindfulness dimensions did not explain the severity of other drug use disorders (MAAS [b_1] = −1.50 [−3.59–.60]; FFMQ nonjudging [b_2] = −.04 [−.31–.22]; FFMQ nonreacting [b_3] = .23 [−.12–.58]). Moreover, we did not find significant total (ab_{total} = .02 [−.07–.07]) and specific (ab_1 = .03 [−.02–.07]; ab_2 = .003 [−.01–.02]; ab_3 = −.02 [−.04–.01]) indirect effects of mindfulness dimensions. We also did not observe significant direct (c' = .004 [−.08–.08]) and total (c = .02 [−.05 −.08]) effects of the DERS total score on SPQ other drugs levels.

The mediating role of mindfulness in benzodiazepines use disorder severity

Mindfulness dimensions did not explain the severity of benzodiazepine use disorders (MAAS [b_1] = −.95 [−2.92–1.02]; FFMQ nonjudging [b_2] = −.06 [−.31–.20]; FFMQ nonreacting [b_3] = −.23 [−.57–.09]). Furthermore, we did not find significant total (ab_{total} = .04 [−.02–.09]) and specific (ab_1 = .02 [−.02–.06]; ab_2 = .00 [−.001–.002]; ab_3 = .001 [−.005–.003]) indirect effects of mindfulness dimension or a significant direct effect (c' = .05 [−.02–.13]) of the DERS total score on SPQ prescription drug levels. However, we found a significant total effect (c = .09 [.03–.15]; p < .01; R^2 = .29) of DER on the severity of benzodiazepines use disorder.

Discussion

In the last 15 years, MBIs have been largely implemented for SUD treatment showing efficacy in supporting abstinence maintenance (14,15) and in improving negative affectivity (16). Consistently, some theoretical frameworks (19,20) have been proposed to explain how mindfulness works in addressing clinical targets, including DER, among SUD individuals. Nevertheless, empirical findings have not definitely identified for which SUD(s) mindfulness could represent a relevant protective factor (24,81). As a result, this study sought to preliminarily examine whether self-regulation of attention and acceptance attitudes related to the mindfulness construct should be considered as significant mechanisms implicated in explaining how a core clinical target in individuals with SUDs, namely DER, contribute to the severity of such disorders.

Consistent with the study hypotheses and independent of the heterogeneity of clinical characteristics, the significance of indirect effects and the absence of direct effect preliminarily support a protective role of mindfulness, especially self-regulated attention mechanisms and the ability to take a nonevaluative stance toward experiences, which fully explains how DER are implicated in AUD severity (4,6). With regard to the protective role of self-regulation attention (i.e. indirect effect and b path), this evidence is consistent with neuropsychological and experimental data among AUD patients that demonstrated impairments and altered functioning of attentional systems

(82–85). Moreover, the relevant role of self-regulation attention in explaining how DER contribute to AUD severity (indirect effect) might be in line with findings reported by Petit and colleagues (86), who showed significant differences in using an attentional deployment emotion regulation strategy (87) in AUD patients compared to healthy controls. The significant indirect effect of self-regulation of attention also suggests how such a process should be considered as an adaptive mechanism of emotion regulation (88–90) which might dampen the well-documented association between negative affectivity and several clinical features associated with AUD (10,13). Considering the indirect effect of the nonjudgmental attitude, this result is fully in line with theoretical frameworks postulating that the development of a nonevaluative and acceptance stance toward experiences reduces both affective reactivity to substance cues and negative affectivity by encouraging more appropriate responses to emotional discomfort (19), and it is consistent with clinical hypotheses that considered nonjudgmental attitude as an adaptive response to ruminative thought patterns (20) strongly associated with negative mood and craving-related content in AUD individuals (e.g., 1, 36). Contrary to study hypotheses, the ability to view psychological events as transient phenomena without reacting to them (FFMQ nonreacting subscale) was not related to AUD severity. Although such ability represents a dimension of mindfulness acceptance (56,57), it also partially reflects other processes, namely decentering or defusion (91,92), which are not fully overlapped with mindfulness construct (93,94) and specifically implicated in AUD (95,96). Accordingly, future research should empirically clarify common and unique aspects characterizing mindfulness acceptance and decentering process (96) by the use of adequate and comprehensive assessment instruments for such dimensions (97), also evaluating their relationships with AUD. In sum, given the previously discussed indirect effects, we might preliminarily conclude that both self-regulation of attention and the ability to take a nonjudgmental attitude toward experiences represent adaptive emotion regulation strategies which explain how DER contribute to AUD severity. As a result, they might be considered relevant mechanisms that several relapse prevention treatments should implement to address the effects of DER and negative affectivity on relevant clinical aspects of AUD (e.g. craving, relapse) (6,10,13,58).

When we controlled for clinical heterogeneity, we did not find a significant total effect of DER on the severity of other drug use disorders. Accordingly, other drug use disorders might be better captured by specific DER, such as impairments in impulse control in the presence of negative emotions (5) or by emotion-based impulsivity dimensions (e.g., positive and negative urgency (98,99)). Moreover, in line with Karyadi and colleagues' meta-analytic findings (24), mindfulness dimensions in the present study were not associated with the severity of other drug use disorders (i.e. *b* paths), as well as no significant indirect effects of mindfulness dimensions were observed. These evidences might suggest that other mechanisms could be considered as protective factors of such disorders, such as distress tolerance, as indicated by prior empirical studies (23,100,101). Similar results were found in relation to the severity of benzodiazepine use disorder. Specifically, mindfulness dimensions did not seem to explain SPQ prescription drug scores (i.e. *b* paths), and they did not demonstrate significant indirect effects on relationship between DER and the severity of benzodiazepine use disorder. Conversely, the results revealed a robust total effect of DER on the previously mentioned disorder. These findings could support further hypotheses concerning alternative mechanisms that are implicated in explaining how DER and negative affectivity might produce their effects on SUDs, namely, experiential avoidance (102–104). However, future longitudinal studies should demonstrate the mediating role of the previous dimension in developing and maintaining benzodiazepine use disorder.

The primary limitation was related to the cross-sectional nature of the study. Indeed, in the absence of longitudinal evaluations, we did not definitively determine a causal effect (105) of DER and mindfulness dimensions on AUD severity. As a consequence, future longitudinal and process-outcome studies should replicate our findings. Future longitudinal studies are also necessary to test alternative mediational models wherein predictor, mediators, and outcomes would be reversed so as to support the theoretical framework adopted in the current work.

Another limitation was related to the assessment instruments. Although we administered valid and reliable questionnaires to evaluate different aspects of mindfulness, the use of self-report questionnaires to assess the previous construct has been called into question, especially for the MAAS (106–108). Nevertheless, we primarily interpreted the MAAS results as a specific aspect of mindfulness referring to self-regulation of attention rather than as a global measure of the mindfulness construct. However, more rigorous assessment procedures should support our interpretations. In particular, future research based on neuropsychological tasks of attentional systems (e.g., Continuous Performance Task; Stroop Task, N-Back, Attentional Network Task) should be carried out to confirm the role of self-regulation of attention in adaptive emotion regulation process and to consider it a protective factor for AUD. Furthermore, future research might include a qualitative assessment of mindfulness with language-

based measurement techniques and interviews (109) in order to better capture mindfulness acceptance dimensions.

Further limitations were also related to the sample characteristics. As previously described, all participants fulfilled the primary diagnosis of AUD according to the DSM-IV-TR, and up to 40% of our sample also had a codiagnosis for other SUDs. Although we controlled for this possible confounding factor, we cannot generalize our findings to other SUD populations. Consequently, future studies should replicate our findings in other SUD samples in order to determine how self-regulation of attention, acceptance attitudes, and the other dysfunctional processes previously mentioned could represent common and unique dimensions in different SUDs.

Despite these limitations, this is the first study that preliminarily demonstrated the role of mindfulness processes as possible protective mechanisms which explain how DER produce their effects on AUD clinical features. Additionally, our results support the need for differential treatment approaches for specific SUDs, hypothesizing unique core pathological dimensions for each disorder. Nevertheless, future longitudinal studies are needed to empirical test how these mechanisms are specifically implicated in developing and maintaining different SUDs.

Declaration of Interest

The authors report no relevant financial conflicts. The authors alone are responsible for the content and writing of this paper.

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