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ORIGINAL PAPER

Impact of Mindfulness Training on Borderline Personality Disorder: A Randomized Trial

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Abstract Recent research suggests that deficits in the ability to be mindful may be related to core aspects of borderline personality disorder (BPD). Mindfulness plays a central role in BPD treatment, and evidence also indicates that mindfulness is the most commonly practiced of the skills taught in dialectical behavior therapy (DBT). The present study investigated whether a 10-week mindfulness training program would improve BPD symptoms and mindfulness-related capacities in a sample of individuals diagnosed with BPD. A total of 64 participants (mean age = 31.64, SD = 6.9; 86 % female) were randomized to 10 weeks of mindfulness ($n = 32$) or interpersonal effectiveness skills training (control group; $n = 32$). BPD symptoms and mindfulness capacities were measured at pre- and post-intervention. Compared to the control group, participants assigned to mindfulness experienced a significantly greater reduction and increase, respectively, in BPD symptoms and decentering capacity. Treatment response rates (in reference to BPD symptoms) were higher for the mindfulness group (40 vs. 13 %). Interpersonal effectiveness alone did not result in improvements on any outcome measures. These findings suggest that mindfulness training may be a useful approach to decreasing BPD symptoms while simultaneously improving mindfulness capacities.

Keywords Borderline personality disorder · Mindfulness · Meditation · Decentering

Trial Registration: ClinicalTrials.gov Identifier: NCT02397031.

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Introduction

Borderline personality disorder (BPD) is a severe psychiatric condition, characterized by a pervasive pattern of emotional dysregulation, impulsivity, interpersonal conflicts, and unstable identity (American Psychiatric Association 2013; Leichsenring et al. 2011). Individuals with BPD are likely to fulfill diagnostic criteria for other psychiatric disorders (Leichsenring et al. 2011; Lieb, Zanarini, Schmahl, Linehan, and Bohus 2004) and are also likely to be frequent users of mental health systems (Bender et al. 2001) and to have difficulties engaging with treatments (Stoffers et al. 2012).

Dialectical behavior therapy (DBT) is the only treatment with sufficient replication to be considered an evidence-based treatment for this disorder (Stoffers et al. 2012). DBT is a multifaceted therapeutic approach (involving individual therapy, group skills training, telephone coaching, and a consultation team for therapists), thus making it a long and expensive treatment. For these reasons, standard DBT is difficult to implement in some clinical settings, and thus, all the components

of the standard intervention are rarely used. Instead, skills training is often used as a stand-alone treatment, without concurrent individual therapy (Soler et al. 2009; Valentine et al. 2015). A recent dismantling study carried out by Linehan et al. (2015) concluded that skills training appears to be a central component to the effectiveness of DBT. Skills training consists of four modules (i.e., mindfulness, emotion regulation, distress tolerance, and interpersonal effectiveness) that target specific areas of dysregulation (Linehan 1993b). The aim of interpersonal effectiveness and emotion regulation skills is to change maladaptive behaviors and emotional responses, while the aim of the other two modules—mindfulness and distress tolerance—is to foster acceptance (Linehan 2014). Several studies have shown that mindfulness and distress tolerance are the two DBT skills most commonly practiced by patients, indicating a preference for acceptance-oriented versus change-oriented skills (Lindenboim, Comtois, and Linehan 2007; Stepp, Epler, Jahng, and Trull 2008).

Among the various skills taught in DBT, mindfulness has been defined as a "core skill" (Linehan 1993b), thus giving it a primary role in DBT. Indeed, mindfulness is among the first skills to be taught, and two sessions of mindfulness are repeated between every other module (Linehan 1993b, 2014). Most definitions state that mindfulness entails a present-centered awareness combined with an attitude of acceptance and openness, which is opposite to the tendency of judging and evaluating the experience (Kabat-Zinn 1990; Linehan 2014). From the DBT perspective, the general aim of mindfulness training is to acquire a state of participation with awareness (Linehan 2014). For that purpose, different skill sets, labeled "what" and "how" skills, are taught (Linehan 1993b, 2014). What skills are oriented toward training patients in what to do when practicing mindfulness (i.e., observe, describe, and participate), while the how skills focus on the attitudinal component of the practice (i.e., taking a non-judgmental stance, focusing on one thing in a particular moment, and being effective). Jointly, these skills guide participants on how to handle undesirable, painful events, or emotions without trying to change or avoid them. Patients are trained in the ability to step back and observe these events in a detached manner, thus fostering decentering and, ultimately, increasing emotion regulation.

In parallel, research has shown that core BPD symptoms—including emotion dysregulation, impulsivity, and interpersonal problems—are related to deficits in mindfulness skills, and these insufficiencies may underlie the clinical manifestations of the disorder (Peters et al. 2013; Wupperman et al. 2008, 2009, 2013). In contrast to healthy controls, individuals with BPD have been shown to have deficits in present-centered awareness and acceptance, together with an elevated tendency to be judgmental toward the inner experience (Linehan 2014; Peters et al. 2013; Wupperman et al. 2009). BPD is also characterized by a lack of decentering (Soler et al. 2014), defined as the ability to observe one's thoughts and feelings in a non-attached manner (Fresco et al. 2007).

Taken together, the evidence described above suggests that mindfulness could be an efficacious approach to treating BPD. However, evidence for the efficacy of mindfulness-based interventions for BPD is still scarce and existing studies on mindfulness interventions for BPD present important methodological shortcomings, including small non-randomized samples, comparison of interventions with uneven doses or formats, and the use of non-specific BPD outcome measures (Feliu-Soler et al. 2014; Sachse et al. 2011; Soler et al. 2012). As a result, it is not possible to raise any definitive conclusions with regard to the true efficacy of mindfulness in BPD. Therefore, studies evaluating mindfulness as an isolated ingredient are strongly needed.

On this basis, this study was designed to evaluate the effects of a stand-alone mindfulness intervention on borderline symptoms and mindfulness-related capacities in patients with BPD. To do so, mindfulness was compared to interpersonal effectiveness (IE) skills training as the control intervention. IE was selected as the control condition for several reasons: (1) to contrast mindfulness training with another psychological intervention rather than a non-active comparison (e.g., waiting list); (2) to control non-specific factors, such as treatment dose (the same number of treatment hours was used in both therapies) and group effect (both interventions were delivered as group therapy, with eight patients per group); and (3) to compare a change-oriented module (IE) with an acceptance-oriented one (M) to assure minimal overlap of therapeutic content. The main aim was to determine whether patients allocated to the mindfulness group would show better outcomes in overall BPD symptomatology than patients allocated to IE. A second objective was to explore the effects of mindfulness and IE training on mindfulness-related capacities.

Method

Participants

Participants were recruited from the outpatient BPD Unit at the Department of Psychiatry at the Hospital de la Santa Creu i Sant Pau (Barcelona, Spain). A total of 92 participants were referred to assess eligibility, and 28 were excluded (19 did not meet inclusion criteria and 9 declined to participate). Thus, a total of 64 participants were included. Given the sample size of 32 and an expected dropout rate of 30 %, the study had a power of 65 %, with the level of significance set at 5 % to detect a moderate effect ($d = 0.6$). Eligibility criteria included the following: (1) BPD criteria according to two diagnostic interviews: the Structured Clinical Interview for DSM-IV-TR Axis II disorders (SCID-II; Gibbon and Spitzer 1997; Gómez-Beneyto et al. 1994) and the Diagnostic Interview for

Borderlines Revised (DIB-R; Barrachina et al. 2004; Zanarini et al. 1989) and (2) age 18–45 years, inclusive. Exclusion criteria were as follows: (1) lifetime diagnosis of schizophrenia, drug-induced psychosis, organic brain syndrome, bipolar disorder, or mental retardation; (2) participation in any psychotherapy during the study or having received DBT in the past; and (3) having meditation/yoga experience (having attended more than one session/class in the past). Participants with comorbid Axis I and Axis II disorders were allowed to participate in the study. Patients were allowed to continue taking any medications prescribed prior to study inclusion, provided that no modifications of the medication type or dose were made during the 10-week intervention period.

Figure 1 shows the study flow chart, including reasons for exclusion and dropouts.

Procedure

This was a single-center, randomized trial including 64 patients allocated to one of two treatment arms: mindfulness training and IE training. Randomized allocation was performed with the online Research Randomizer (www.randomizer.org/form.htm), a program that generates 16 sets of 4 numbers each (ranging from 1 to 2 for M and IE, respectively). To obtain the same sample size in each treatment arm, allocation had to be perfectly balanced every four sets. Each group comprised eight individuals corresponding to four consecutive sets of randomization. The research unit coordinator (not blind to treatment condition) was responsible for the randomization process. Study enrolment took place from December 2011 to January 2014. A trained psychiatrist and two psychologists familiar with screening interviews, who were blind to treatment arms, conducted diagnostic interviews. The interviewers presented a high inter-rater reliability (within-class correlation 0.94). Baseline assessments were conducted a maximum of 1 week before treatment initiation and post-treatment assessments within 1 week of completing the 10-week intervention. Participants completed assessments in the presence of a psychologist from our unit. Informed consent was obtained from all individual participants included in the study. No financial payments were made for study participation. The study was approved by the ethics committee of the Hospital de la Santa Creu i Sant Pau and carried out in accordance with the Declaration of Helsinki.

Interventions Participants met once a week in groups of eight for ten consecutive weeks, with each session 150 min in duration. Sessions for both intervention modalities (i.e., M and IE) followed the same structure. Sessions began with the review of home-based tasks, each participant was asked to comment on her/his practice and difficulties during the week, and therapists provided corrective feedback and reinforcement (60 min). Homework completion in both groups was tracked with recording sheets (diary card). In the second part of the session, a new skill was presented with step-by-step instructions on how to use/perform it (60 min). Metaphors, discussions, and in vivo role plays were used to ensure that participants had understood the rationale for the skill and how to use it. Sessions ended with homework assignments (30 min), which consisted of practicing during the week the skills presented in each session.

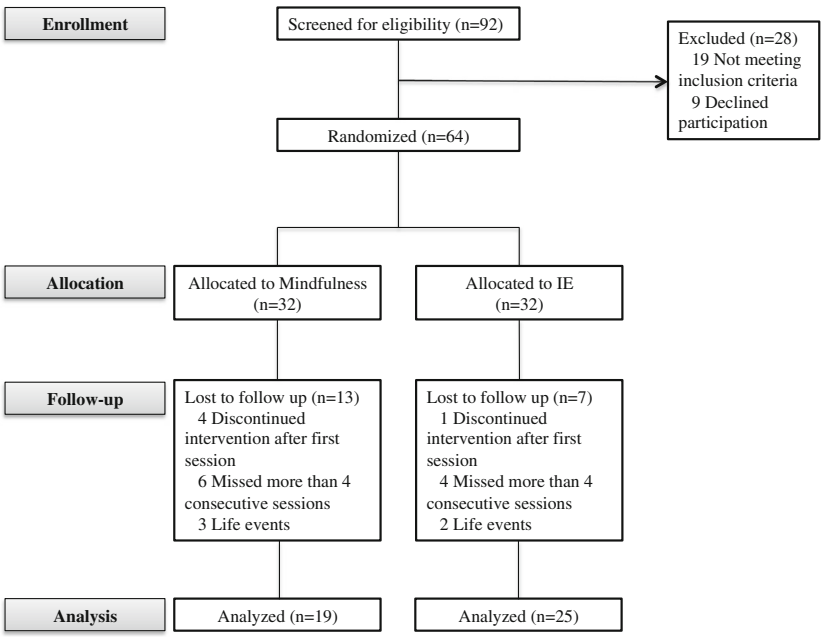

Fig. 1 Consolidated Standards for Reporting Trials (CONSORT) showing the flow of participants through the study. *ITT* intention to treat, *PP* per protocol

Mindfulness Mindfulness training preserved the essence of mindfulness skills taught in DBT, embracing the dialectical basis of the treatment, treatment strategies, and targets. For the specific aim of this study, mindfulness skills were taught in ten consecutive weeks and formal mindfulness practices were encouraged and reinforced.

Mindfulness training consisted in learning what skills (i.e., observe, describe, participate) and how skills (i.e., taking a non-judgmental stance, focusing on one thing in the moment, and being effective). To foster these skills, participants were instructed to practice both formal and informal mindfulness (Linehan 1993b, 2003, 2004). Considering that formal practice may be especially challenging for BPD patients (Dimidjian and Linehan 2003), participants were free to choose the length of each practice. However, the following instruction was given: "once you decide to finish the exercise, continue to practicing it for at least one more minute, even if it is uncomfortable" (Soler et al. 2012). Participants received a CD with all formal meditations. Each session started with a review of the homework (50 min). Thereafter, a new mindfulness skill was introduced and practiced in session (80 min) and the session ended with homework assignment (20 min). Session 1 started by giving an orientation to skills training and explaining the biosocial theory for BPD; then, an overview of the mindfulness module was given. In session 2, the mindfulness "wise mind" skill was presented. The goal of this skill is to help participants to find a synthesis between "emotion mind" and "reasonable mind," with the former characterized by the predominance of emotional states and mood-dependent thinking and behavior whereas the latter is characterized by intellectual knowledge, logical thinking, and a practical and "cool" approach to problems. When activating wise mind, participants are able to break extreme patterns of behavior, cognition, and emotional responses guided by emotion mind or reasonable mind, by adding to emotion mind and reasonable mind an intuitive knowing (Linehan 2014). Thereafter (between sessions 3 and 6, both included), "what skills" and "how skills" were presented as vehicles to achieve wise mind. What skills are about what to do: (1) observe (i.e., noting and attending to the ongoing experience), (2) describe (i.e., applying verbal labels to what has been observed, including events, thought, emotions, bodily sensations), and (3) participate fully in the current moment. The first two skills are essential skills for learning a new behavior and to constrain mood-dependent tendencies. Once a new behavior is learned, one can "participate" fully in the experience while being aware of it. The other three skills (i.e., how skills) instruct the patients how to observe, describe, and participate: (1) in a non-judgmental manner, (2) focusing on one thing at a time, and (3) being effective (i.e., focusing on doing what is needed in a particular situation, rather than focusing on being "right"). To practice both what and how skills, patients were instructed in several formal and informal mindfulness practices (see Table 1). Sessions 7, 8, and 9 focused on practicing acceptance-oriented skills, a core component of mindfulness practice itself (Bishop et al. 2004; Linehan 2014). Acceptance skills were taken from the distress tolerance module to reinforce the attitudinal component of mindfulness practice. The objective of session 10 was to summarize the treatment content and motivate patients to continue practicing at home.

Interpersonal Effectiveness As in mindfulness training, IE skills training also sought to preserve the essence of DBT, following its treatment strategies and targets. Session 1 began with an overview of the skills training and the biosocial theory for BPD. After that, an overview of the IE module was given, stressing the overall aim of IE skills training: to increase the patient's repertoire of effective social behavior. Session 2 was dedicated to clarifying the goals of IE, instructing patients on how to decide the importance of the three effectiveness types: objectives effectiveness, relationship effectiveness, and self-respect effectiveness. All the factors that may reduce IE were discussed in session 2. During the IE training, a new skill was presented in one session and the following session was used to strengthen the acquisition and generalization of that skill (Table 1). Between sessions 3 and 8 (inclusive), core interpersonal skills targeting the three types of effectiveness were taught. Two consecutive sessions were dedicated to each of the three effectiveness types (Table 1). In sessions 3 and 4, participants learned objective effectiveness, which refers to the ability to obtain an objective or goal in a particular situation (e.g., requesting something, refusing something, or resolving a conflict). Sessions 5 and 6 were dedicated to "relationship effectiveness," including skills for keeping and improving relations and validation skills. In sessions 7 and 8, participants learned how to defend their self-respect. Session 9 was dedicated to building skills to manage or make requests. As in mindfulness training, session 10 was dedicated to summarizing the whole training program and to troubleshoot any difficulties in applying the skills in the future. Each session began with a review of tasks during the week (60 min). Sessions ended with homework assignment (30 min).

A detailed training schedule for both groups is summarized in Table 1.

Psychotherapists Each group therapist ($n=4$) was responsible for treating one treatment group ($n=8$) in each of the two study groups. All of the therapists (two males, two females) were licensed psychologist, three with a Master's degree in psychology and one with a PhD. The average length of clinical experience was 7 years (SD = 5.4). All therapists were trained in DBT and had personal experience with mindfulness practice. Two psychiatrists provided psychotropic medication. Other team members followed each therapy session using a closed-circuit television, enabling supervision and feedback.

Table 1 Summary of the skills training curriculum for both interventions

	Mindfulness	Interpersonal effectiveness
1	Overview of skills training/biosocial theory of BPD. Overview of mindfulness skills: orienting participants to M practice.	Overview of skills training/biosocial theory of BPD. Overview of IE skills: orienting participants to IE practice.
2	States of the mind: emotion mind, reasonable mind and wise mind. Examples for practicing wise mind: breath in "wise mind," breath out "letting go".	Clarifying goals of IE, deciding the importance of the three effectiveness types. Factors reducing IE.
3	What and how skills: overview. Observe. FP examples (external observation): observing the breath, observing sounds, observing a physical sensation. IP example: observing a landscape.	Objective effectiveness: Describe, Express, Assert, Reinforce, Stay Mindful, Appear confident, Negotiate (DEAR MAN)
4	Observe/One-Mindfully. FP example: observing thoughts (internal observation). IP examples for practicing one mindfully: cleaning the house, washing dishes.	
5	Describe/non-judge. FP examples: describing thoughts, physical sensations. IP examples for practicing describing/non-judgmentalness: describing a person's face, describing a landscape, counting judgments—replacing them with non-judgmental descriptions of the dislike or the negative consequences-.	Relationship effectiveness: be Gentle, act Interested, Validate, Easy manner (GIVE)
6	Participating/being effective FP examples: mindful dancing/group walking meditation. IP examples: dance, sing, go running, group games.	
7	Choosing to accept: turning the mind.	Self-respect effectiveness: be Fair, no Apologies, Stick to values, be Truthful (FAST).
8	Learning to respond wisely and effectively to events: willingness over willfulness.	
9	Accepting with the body: half-smile	Evaluating options: how intensely to ask or say no.
10	Summary of the training.	Summary of the training.

FP formal practice, *IF* informal practice, *M* mindfulness, *IE* interpersonal effectiveness

Video cameras transmitted a signal for viewing but did not record the sessions.

Measures

Diagnostic Measures The Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II; Gibbon and Spitzer 1997; Gómez-Beneyto et al. 1994) and the Diagnostic Interview for Borderlines Revised (DIB-R; Barrachina et al. 2004; Zanarini et al. 1989) were used to establish BPD diagnosis and Axis II comorbidities. The DIB-R was used to assess BPD diagnosis over the last 2 years. The cutoff score for the Spanish version is 6 (range 1 to 10); higher scores represent increased severity of borderline symptoms (Barrachina et al. 2004).

Axis I comorbidities were assessed with the Psychiatric Diagnostic Screening Questionnaire (PDSQ; Pérez Gálvez et al. 2010; Zimmerman and Mattia 2001). The PDSQ contains 13 subscales to screen for the following: major depressive disorder, bulimia, post-traumatic stress disorder, panic disorder, agoraphobia, social phobia, generalized anxiety disorder, obsessive-compulsive disorder, alcohol abuse/dependence, drug abuse/dependence, somatization, hypochondriasis, and psychosis. Depending on the subscale, participants were asked to rate the items considering the last 2 weeks (for major depressive disorder, bulimia, post-traumatic stress disorder, panic disorder, and psychosis) or the last 6 months (for agoraphobia, social phobia, generalized anxiety disorder, obsessive-compulsive disorder, alcohol abuse/dependence, drug abuse/dependence, somatization, and hypochondriasis).

Borderline Severity This was the primary outcome measure. Borderline symptoms were assessed through the Borderline Symptoms List-23 (BSL23; Bohus et al. 2008; Soler et al. 2013) before and after the interventions to evaluate clinical improvement. Patients were asked to rate each item on a five-point Likert scale from 0 (not at all) to 4 (very strong) to indicate their current status for each item versus the prior week. Higher scores on the BSL-23 indicate more severe BPD symptomatology. This instrument has shown good psychometric properties: high internal consistency (Cronbach's alpha = 0.95) and good test-retest reliability ($r = 0.73$; $p < 0.01$). In addition, it has proven to be sensitive to the effects of therapy (Soler et al. 2013).

Mindfulness Facets Changes in mindfulness facets were measured by the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al. 2006; Cebolla et al. 2012). The FFMQ is a 39-item instrument for assessing five components of mindfulness consistent with the DBT framework: (1) observing (noticing external and internal experiences, e.g., body sensations, thoughts, or emotions), (2) describing (putting words to or labeling the internal experience), (3) acting with awareness (focusing on the present activity instead of behaving mechanically), (4) non-judging the inner experience (taking a non-evaluative stance toward the present experience, thoughts, or emotions), and (5) non-reactivity to the inner experience (allowing thoughts and feelings to come, without getting caught up in or carried away by them). Participants were asked to rate the degree of concordance with each statement on a five-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true); higher scores indicate greater levels of dispositional mindfulness. For the purpose of the study, the timeframe used for the assessment was the prior week. The FFMQ has shown adequate psychometric properties in both non-clinical and clinical samples. Cronbach's α for the Spanish version of FFMQ ranges from 0.8 to 0.91 (Cebolla et al. 2012).

Decentering As part of a wider vision of the mechanism of action of mindfulness-based interventions, the decentering subscale of the Experience Questionnaire (EQ) was also administered (Fresco et al. 2007; Soler et al. 2014). This 11-item self-reported scale measures decentering, defined as the capacity to observe one's thoughts and emotions as temporary events of the mind. Participants rate items on a seven-point Likert-type scale (from 1 = never, to 7 = all the time), to indicate their current status for each item versus the prior week. Higher scores on this scale suggest a higher capacity of decentering. Psychometric properties of the scale are satisfactory, and EQ is also able to detect changes after a mindfulness intervention (Soler et al. 2014).

Data Analyses

In accordance with the statistical plan analysis, analyses were conducted on both per-protocol (PP) and intention-to-treat (ITT) samples. ITT analyses included all enrolled participants ($n = 64$), regardless of whether they completed the intervention or not. PP analyses comprise only participants who completed at least 80 % of the intervention (completers), and for whom, all data points (pre- and post-intervention) are available (M group: $n = 19$; IE group: $n = 25$). Missing data were treated with the last observation carried forward (LOCF) method (Little and Rubin 1987).

Patient demographic and baseline characteristics were compared using the chi-square test for categorical variables and the t test for continuous variables. Kaplan-Meier survival analysis was performed to estimate differences between groups in time to treatment dropout. A repeated measures ANOVA was used to test the main hypothesis. BSL-23 scores were entered as the dependent variable; the treatment arm was the between-subject factor, and time (pre- and post-intervention) was the within-subject factor. Cohen's effect sizes were also calculated. Reliable and clinically significant improvements (RC and CSC, respectively) regarding the main outcome measure (BSL-23) were calculated for the ITT sample following Jacobson and Truax (1991) criteria. Treatment response (i.e., RC) was calculated in order to determine the percentage of patients who reliably improved after both interventions. The formula was as follows:

$$\mathrm{RCI} = \frac{X_{\mathrm{pre}} - X_{\mathrm{post}}}{S_{\mathrm{diff}}}, \quad \text{where} \quad S_{\mathrm{diff}} = \sqrt{2*(\mathrm{SE})^2} \quad \text{and} \quad \mathrm{SE} = \mathrm{SD}*\sqrt{1-r_{tt}}$$

X_{pre} = group mean at the beginning of treatment

X_{post} = group mean at the end of treatment

SD = Standard deviation

r_{tt} = Reliability of the measurement instrument (Cronbach's alpha)

To calculate the standard error (SE), we referred to a reference population of BPD outpatients (Soler et al. 2013, SD = 17.94, Cronbach's alpha = 0.95). To establish whether responsive participants reached remission criteria and considering that non-patient normative data is not available for the BSL-23, CSC was defined as reaching a level of functioning in post-treatment greater than two standard deviations below the pre-treatment sample mean (CSC cutoff = 35.88).

Two repeated-measures ANOVAs were conducted for secondary variables: decentering (with EQ scores) and mindfulness facets (using FFMQ subscales scores). Post hoc analyses were carried out when significant interactions were found. A lineal regression model was performed to explore the predictive effect of changes in EQ and FFMQ upon changes in BSL-23 scores. All data was analyzed with IBM PASW v.19. The level of significance was set at 0.05 (two-tailed).

Results

Demographic and clinical characteristics of enrolled participants are shown in Table 2. Comparisons between the two groups indicated no mean differences at pre-intervention in either clinical or demographic data. Most participants were women (86 %), with a mean age of 30 years. All participants were Caucasian. All participants in both groups had at least one comorbid Axis I diagnosis, including anxiety disorders, major depressive disorder, and substance abuse. Among Axis II disorders, 31 % of the sample had a comorbid cluster C diagnosis, followed by cluster A (30 %) and cluster B (26 %). Most of the sample was under pharmacological treatment, mainly antidepressants and benzodiazepines.

The dropout rate for mindfulness was higher than in the control group (41 vs.19 %; see Fig. 1 for reasons to dropouts). Frequency of session completion is the following: in the M group, 32 completed one session, 28 completed two sessions, 25 completed three sessions, 24 completed four sessions, 21 completed five sessions, 20 completed six and seven sessions, and 19 completed eight, nine, and ten sessions. In the IE group, 32 completed one session, 31 completed two, three, and four sessions, 30 completed five sessions, 29 completed six sessions, 26 completed seven sessions, and 25 completed eight, nine, and ten sessions. Time to treatment dropout did not differ significantly between groups ($p = 0.07$, see Fig. 2 Kaplan-Meier survival analysis).

For BSL-23 scores, the repeated measures ANOVA showed a significant interaction of treatment group × time in both ITT [$F(2, 62) = 13.05$, $p = 0.001$, CI 95 % (0.38, 1.41), $d = 0.90$)] and PP sample [$F(2, 42) = 18.93$, $p < 0.0001$, CI 95 % (0.65, 1.96), $d = 1.32$)] (see Fig. 3). Post hoc analysis on the ITT sample showed that the mindfulness group improved significantly on BSL-23 scores [$t(31) = 3.92$, $p = 0.0004$], whereas the IE group did not [$t(31) = -1.06$, $p = 0.29$]. When mixed models were run, findings were almost the same: $F = 9.88$; $df = 1, 105.92$; $p = 0.002$; Cohen's $d = 0.78$, 95 % CI [0.26–1.28]. Table 3 shows pre-post intervention

Table 2 Baseline demographic and clinical characteristics by group

Variable	Mindfulness ($n = 32$)		Interpersonal effectiveness ($n = 32$)		X^2	t	p
Demographic characteristics							
Gender, *n* (% of females)	27	(84.4)	28	(87.5)	0.13	–	0.71
Age, mean (SD)	31.56	(7.25)	31.72	(6.82)	–	0.09	0.93
Education, *n* (%)							
Primary	7	(22.6)	6	(19.4)	1.77	–	0.43
Secondary	13	(41.9)	18	(58.1)			
University	11	(35.5)	7	(22.6)			
Marital status, *n* (%)							
Single	20	(62.5)	16	(50.0)	1.73	–	0.42
Married/stable couple	9	(28.1)	14	(43.8)			
Separated/divorced	3	(9.4)	2	(6.2)			
Clinical characteristics							
DIB-R total score, mean (SD)	7.90	(1.04)	8.03	(1.56)	–	0.39	0.69
BSL-23, mean (SD)	45.87	(19.60)	49.40	(20.03)	–	0.71	0.47
Current Axis I diagnoses, *n* (%)							
Any anxiety disorder	26	(81.2)	29	(90.6)	1.16	–	0.28
Major depressive disorder	20	(62.5)	24	(75.0)	1.16	–	0.28
Any substance abuse disorder	20	(62.5)	24	(77.4)	1.66	–	0.19
Bulimia	14	(43.8)	17	(53.1)	0.56	–	0.45
Axis II diagnoses, *n* (%)							
Cluster A diagnoses	10	(37.0)	9	(30.6)	0.32	–	0.57
Other Cluster B diagnoses	7	(25.9)	10	(33.3)	0.37	–	0.54
Cluster C diagnoses	10	(37.0)	10	(33.3)	0.08	–	0.77
Pharmacological treatment, *n* (%)							
Antidepressant	25	(83.3)	17	(65.5)	2.39	–	0.12
Benzodiazepines	15	(50.0)	14	(53.8)	0.08	–	0.77
Antipsychotics	13	(43.3)	11	(42.3)	0.01	–	0.93
Mood stabilizers	5	(16.7)	2	(7.7)	1.02	–	0.31

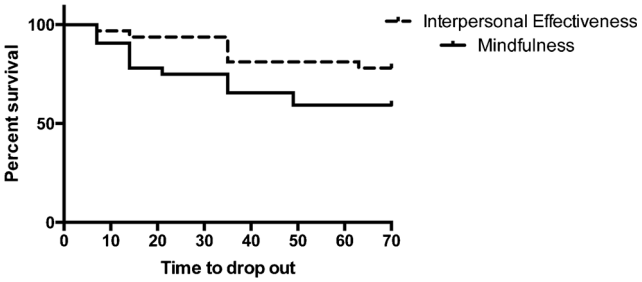

Fig. 2 Survival analysis for time to dropout. The treatment period was 10 weeks (i.e., 70 days)

scores on BSL-23 (*M* and SD), group × time interactions, and Cohen's *d* for ITT and PP samples.

Clinical change was calculated for BSL-23 scores (only in the ITT sample). For a patient to be regarded as having responded to treatment, the difference between pre- and post-treatment mean scores had to exceed 11.12 points. In the M group, 12 participants (40 %) showed response rates after treatment, whereas only 4 participants (13 %) in the IE group showed a reliable reduction. Of those 12 participants in the M group, 5 (42 %) reached a significant clinical change (CSC cutoff = 35.88). Of the subjects in the IE group who displayed a reliable reduction, only one also fulfilled criteria for remission.

A significant group × time interaction was found for EQ scores in both the ITT [$F(2, 62) = 6.03$, $p = 0.017$, CI 95 % (0.11, 1.11), $d = 0.61$] and PP [$F(2, 42) = 12.19$, $p = 0.001$, CI 95 % (0.41, 1.68), $d = 1.06$] samples. A significant increase in decentering was observed for the mindfulness group: ITT [$t(31) = -5.57$, $p < 0.001$] and PP [$t(18) = -9.85$, $p < 0.0001$]. No significant pre-post differences were observed for the IE group [ITT $t(31) = -1.06$, $p = 0.29$; PP $t(24) = -1.06$, $p = 0.29$].

The multivariate repeated measures ANOVA using FFMQ scores yielded a significant group × time interaction in the PP sample [$F(5,38) = 2.51$, $p = 0.047$]. Post hoc analyses showed an improvement in the mindfulness group on two FFMQ facets: describing [$t(18) = -2.72$, $p = 0.01$] and non-Judging [$t(18) = -3.53$, $p = 0.002$]. Although the interaction of the univariate analysis for non-reacting was not significant, pre-post

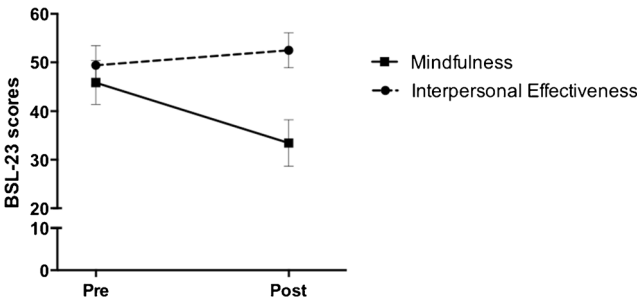

Fig. 3 Differences between mindfulness group and interpersonal effectiveness group in the primary outcome measure: BSL-23. Figure shows mean scores and standard error measures in the ITT sample. Repeated measures ANOVA group × time effect: $F(1,62) = 13.05$, $p = 0.001$

comparison showed a significant pre-post difference in the mindfulness group [$t(18) = -6.60$, $p = 0.000003$]. No significant pre-post comparisons in regard to FFMQ subscales were found for the IE group (data not shown). A repeated measures MANOVA was also performed in the ITT sample, but the significant group × time interaction was not maintained [$F(5,58) = 2.22$, $p = 0.31$]. Analyses of secondary outcomes are detailed in Table 4.

To determine to what extent changes in decentering and mindfulness facets were predictors of changes in borderline symptoms, a forward stepwise multiple linear regression model was performed. Changes in BSL-23 (Δ BSL-23) were entered as the predicted variable. Predicting variables were as follows: treatment group, changes in EQ (Δ EQ), and changes in describe and non-judge facets from the FFMQ (Δ describe and Δ non-judge). Changes in EQ explained 27 % of the variance ($B = -1.59$, SE = 0.33, $\beta = -1.33$, $p = 0.00018$), and when the treatment group was added, the explained variance increased significantly to 34.5 % ($B = -10.71$, SE = 4.03, $\beta = -10.71$, $p = 0.010$; F-change ($df_1 = 62$; $df_2 = 61$) = 7.05, $p = 0.01$). None of the other factors was able to significantly improve the prediction.

Discussion

The present study is a preliminary investigation to determine the efficacy of mindfulness training as an intervention to treat BPD symptoms. Compared to IE, we found that mindfulness training was more efficacious in reducing BPD severity. Amelioration of borderline symptoms after the mindfulness intervention was both statistically as well as clinically significant, as evidenced by a response rate of 40 % (versus 13 % in the IE group). In addition to borderline core symptomatology, mindfulness also improved decentering and some mindfulness facets (i.e., non-judging and describing). By contrast, no such improvement was observed in participants who received IE skills. Interestingly, the findings of the regression model may be consistent with the possibility that changes in decentering precede the reduction in symptom severity in the M group.

Our results show that borderline symptoms diminished significantly in participants who received mindfulness training, as evidenced by higher response rates in the mindfulness group. This large decrease in borderline symptoms after mindfulness training—in contrast to the control intervention—supports the mindfulness-deficit model of BPD (Peters et al. 2013; Wupperman et al. 2008). Additionally, such benefits may explain why mindfulness skills are the most widely practiced among the whole DBT skills package (Lindenboim et al. 2007; Stepp et al. 2008). By contrast, BPD symptoms were not significantly improved after IE training. To date, there is no evidence on the specific effects of stand-alone IE skills, although one might expect that IE training may have greater

Table 3 Per-protocol and intention-to-treat analyses of primary outcome (BSL-23) by group

	Intention to treat [a] (BSL-23)							Per protocol[b] (BSL-23)						
	Pre		Post		Group × time interaction		Cohen's *d* [95 % CI]	Pre		Post		Group × time interaction		Cohen's *d* [95 % CI]
	M	SD	*M*	SD	*F*	*p*		*M*	SD	*M*	SD	*F*	*p*	
Mindfulness	45.87	19.60	33.46*	20.97	13.05	0.001	0.90 [0.38, 1.41]	48.94	18.04	28.08*	19.23	18.93	<0.0001	1.32 [0.65, 1.96]
Interpersonal effectiveness	49.40	20.03	52.50	18.10				49.20	20.42	53.16	17.88			

Effect sizes refer to pre- and post-treatment differences

BSL-23 Borderline Symptom List-23, *M* mean, *SD* standard deviation

*Pre- and post-intervention post hoc *t* tests, $p < .0001$

[a] $n = 32$ in each group

[b] $n = 19$ in the mindfulness group and $n = 25$ in the interpersonal effectiveness group

impact on social abilities than on other core BPD symptoms. Therefore, the lack of improvement after IE observed here could be due to the fact that interpersonal symptoms were not directly measured. On the other hand, the sequence in which skills are taught during standard DBT's skills training (i.e., mindfulness precedes all the other skills) may impact on the efficacy of IE. Indeed, in our study, skills training was randomized in such a way that half of the patients received IE while the other half received mindfulness, so the probable benefits of receiving mindfulness before IE training could not

Table 4 Analyses of secondary outcomes (EQ and FFMQ) by group

Analysis/variable	Mindfulness				Interpersonal effectiveness						
	Pre		Post		Pre		Post		Group × time interaction		Cohen's *d* [95 % CI]
	M	SD	*M*	SD	*M*	SD	*M*	SD	*F*	*p*	
Intention to treat[a]											
EQ	22.96	6.02	27.81	6.68	24.71	7.64	25.96	6.02	6.03	0.017	0.61 [0.11, 1.11]
FFMQ											
Observe	24.78	6.44	26.40	4.75	25.06	6.49	25.34	6.38	.90	0.34	0.24 [−0.26, 0.73]
Describe	21.40	8.52	24.50	6.70	22.18	7.62	22.15	6.86	3.65	0.06	0.48 [−0.03, 0.97]
Act with awareness	16.90	5.57	18.56	5.95	19.09	7.14	19.75	5.92	.58	0.44	0.19 [−0.30, 0.68]
Non-judge	16.59	5.85	19.93	7.44	16.87	5.41	17.53	6.49	3.20	0.08	0.45 [−0.05, 0.94]
Non-react	14.00	4.61	16.90	4.48	13.90	5.61	15.59	3.92	1.25	0.26	0.28 [−0.22, 0.77]
Per protocol[b]											
EQ	22.26	4.81	30.42*	4.59	25.08	8.60	26.68	7.15	12.19	0.001	1.06 [0.41, 1.68]
FFMQ											
Observe	24.57	8.03	27.31	5.47	24.92	7.08	25.28	6.95	1.33	0.25	0.35 [−0.26, 0.94]
Describe	20.52	9.81	25.73*	6.82	22.36	8.02	22.32	7.08	5.11	0.03	0.69 [0.06, 1.29]
Act with awareness	17.57	6.66	20.36	6.38	19.20	7.72	20.04	6.23	1.04	0.31	0.31 [−0.30, 0.90]
Non-judge	16.68	6.23	22.31*	7.79	17.08	5.88	17.92	7.11	5.24	0.03	0.84 [0.21, 1.45]
Non-react	13.89	5.03	18.78**	3.76	13.84	6.29	16.00	4.24	3.51	0.07	0.57 [−0.05, 1.17]

Effect sizes refer to pre- and post-treatment differences

EQ Experiences Questionnaire, *FFMQ* Five Facet Mindfulness Questionnaire, *M* mean, *SD* standard deviation

*Pre- and post-intervention post hoc *t* tests, $*p = 0.01$,$**p < 0.000$

[a] $n = 32$ in each group

[b] $n = 19$ in the mindfulness group and $n = 25$ in the interpersonal effectiveness group

be assessed. It is noteworthy that the high effect size observed for mindfulness could also be explained by the small effect size observed for IE.

Together, these data could be valuable when choosing the treatment curricula in clinical settings in which the use of standard DBT may be especially challenging. In line with the dismantling study published by Linehan et al. (2015) in which DBT skills training as a stand-alone treatment was compared to standard DBT and to individual DBT, a dismantling study of DBT skills training might be of value. If the four DBT modules were assessed in a dismantling study, it could help mental health professionals to tailor interventions to reduce BPD symptoms by identifying the contributions of each module versus the "combined effect" of the four modules. Another closely related aspect involving standard DBT is the duration of the interventions. Our findings demonstrate that a 10-week intervention can improve symptoms in a population with severe symptomatology, confirming previous evidence on the efficacy of brief interventions for BPD (e.g., Soler et al. 2009; Stoffers et al. 2012). This does not mean that BPD treatment should be restricted to10 weeks, but rather, this underscores the need to evaluate the possibility of shortening skills training without affecting its efficacy.

Although the reduction in BPD symptoms through mindfulness training is encouraging, this result has to be interpreted cautiously, for several reasons. First, the dropout rate was higher in the mindfulness group (40 vs. 19 % for the control group). The dropout rate in this study was also higher than the ones reported previously for mindfulness training [e.g., 30 %; (Soler et al. 2012)]. Differences in retention rates between the two study groups cannot be attributed to baseline differences between completers and non-completers, as they were comparable on all relevant characteristics (data not shown). In addition, reasons for treatment's termination were similar for both groups, with the exception of abandonment after the first session, which was greater in the mindfulness group. The better retention in the IE group could be explained by the perception that the content of the intervention is more directly related to typical BPD symptoms. Given that mindfulness does not imply a direct modification of symptoms but rather promote a new attitude toward these symptoms, the connection between mindfulness practice and symptom improvement may not be explicit enough to engage participants into the training. Other reasons for the higher dropout rate in the mindfulness group could include motivational aspects, an unwillingness to tolerate emotional distress (Kröger et al. 2013), or difficulties in practicing formal mindfulness meditation (Dimidjian and Linehan 2003). Nevertheless, it is relevant to mention that the statistical significance of pre-post treatment changes in BSL-23 was also maintained in the analysis of the ITT sample, in which participants who dropped out were considered to have not responded to treatment.

Similarly, mindfulness training was associated with improvements in decentering, whereas IE training did not induce any such changes. Moreover, changes in decentering seemed to be a predictor for reduced symptoms. Although our analyses may not be sufficient to conclude that decentering enhancement is a mechanism of change of mindfulness training, as proposed by Hayes-Skelton et al. (2015), our results do support this hypothesis, entailing relevant clinical implications. Enhancement of decentering might diminish maladaptive strategies such as avoidance or suppression (Hayes-skelton et al. 2015), and this may be particularly important in the treatment of BPD given that a major target of mindfulness practice is to teach the patient how to constrain mood-dependent behaviors (Linehan 1993b).

Other mindfulness capabilities were measured by the FFMQ (Baer et al. 2006). The analyses conducted in the PP sample showed that not all facets improved with mindfulness training. However, two facets showed notable improvement: non-judging the inner experience and describing. The decrease in judgmental tendencies could be related to gains in acceptance, a critical component of mindfulness practice (Bishop et al. 2004). Acceptance is often impaired in BPD populations (Peters et al. 2013; Wupperman et al. 2008), in part due to the frequent presence of traumatic and invalidating experiences (e.g., Linehan 1993a; Martín-Blanco et al. 2014). Improvements in describing—a skill that is characteristic of the DBT framework—are also relevant, as previous evidence has linked the ability to describe with enhanced emotion regulation (Creswell et al. 2007). However, the fact that statistical significance was not maintained in ITT analyses (versus the PP analysis) compromises these results, indicating that more research is warranted to verify the effects of mindfulness training on these two facets.

Although the results of this randomized study are encouraging with regard to the effectiveness of mindfulness training in reducing BPD symptoms and increasing decentering, these findings must be interpreted with caution. The main limitation of our study is the number of dropouts, which was higher than the attrition rate expected in power calculations, and therefore may have biased the estimation of treatment effects. Notwithstanding this caveat and the relatively small sample size, the statistical improvements in both the ITT and PP samples, the large effect sizes (ITT sample $d = 0.90$), and the reliability indices and clinically significant changes make our findings robust. Even when mixed models (not reported here) were run to account for the missing data, the effect size was still significant and clinically relevant. Another limitation of the present study is the absence of a treatment adherence measure (TAM), in part because no validated TAM is available in Spanish. However, we mitigated the lack of a TAM by ensuring supervision of treatment sessions by other team members.

Additionally, we did not assess patient preferences for the two intervention modalities, which could be a possible source of bias (Mott et al. 2015). Future studies should also consider the amount and frequency of practice as a variable that could be related to the efficacy of the skills training. Another potential limitation is that the therapists were not completely blinded to the study hypothesis. In addition, since self-report instruments were used as outcome measures, our results may be more representative of a subjective improvement rather than an actual decrease in symptoms; nevertheless, it is worth mentioning that BSL-23 has high convergent validity compared to clinician-administered instruments for rating BPD, such as the DIB-R (Soler et al. 2013). Finally, the absence of follow-up assessments does not allow us to draw conclusions with regard to the temporal stability of our findings. Future studies should investigate if the efficacy of mindfulness training is long-standing and whether treatment engagement depends on individual characteristics not assessed in this study. Identifying these characteristics is important to apply mindfulness-based prescriptions that better fit the individuals.

In summary, the results of this preliminary clinical trial suggest that mindfulness training is an efficacious treatment approach to reduce borderline symptoms. In spite of the preliminary nature of our study, the clinical implications of these results are promising. This study suggests that the benefits of mindfulness practice may go beyond core borderline psychopathology by also increasing mindfulness-related components as decentering or the capacity for non-judging. Specifically, improvements in decentering could be clinically valuable in this patient population. Given the differential impact of mindfulness versus IE training on borderline symptoms, it would be interesting to focus future studies on exploring the specific targets of the various DBT skills and on unraveling the active components of DBT skills training. Further research is also needed to determine if increases in decentering underlie the beneficial effect of mindfulness training in BPD populations.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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