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Internet-Based Mindfulness Treatment for Anxiety Disorders: A Randomized Controlled Trial

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Mindfulness-based interventions have proven effective for the transdiagnostic treatment of heterogeneous anxiety disorders. So far, no study has investigated the potential of mindfulness-based treatments when delivered remotely via the Internet. The current trial aims at evaluating the efficacy of a stand-alone, unguided, Internet-based mindfulness treatment program for anxiety.

Ninety-one participants diagnosed with social anxiety disorder, generalized anxiety disorder, panic disorder, or anxiety disorder not otherwise specified were randomly assigned to a mindfulness treatment group (MTG) or to an online discussion forum control group (CG). Mindfulness treatment consisted of 96 audio files with instructions for various mindfulness meditation exercises. Primary and secondary outcome measures were assessed at pre-, post-treatment, and at 6-months follow-up.

Participants of the MTG showed a larger decrease of symptoms of anxiety, depression, and insomnia from pre- to postassessment than participants of the CG (Cohen's $d_{between}$ = 0.36-0.99). Within effect sizes were large in the MTG (d = 0.82–1.58) and small to moderate in the CG (d = 0.45–0.76). In contrast to participants of the CG, participants of the MTG also achieved a moderate improvement in their quality of life.

The study provided encouraging results for an Internet-based mindfulness protocol in the treatment of primary anxiety disorders. Future replications of these results will show whether Web-based mindfulness meditation can constitute a valid alternative to existing, evidence-based cognitive-behavioural Internet treatments.

The trial was registered at ClinicalTrials.gov (NCT01577290).

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ANXIETY DISORDERS ARE THE MOST PREVALENT AMONG the mental disorders. In the United States, lifetime

prevalence rates suggest that every third to every fourth individual experiences symptoms of an anxiety disorder once in his or her life (Kessler, Berglund, et al., 2005). Twelve-month prevalence rates vary between 14%–18% in Europe and Northern America (Kessler, Chiu, Demler, & Walters, 2005; Wittchen et al., 2011). Anxiety disorders are often comorbid with affective and somatic disorders and are associated with greater impairments, higher severity, and a more chronic course (e.g., Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Klein Hofmeijer-Sevink et al., 2012). Anxiety disorders lead not only to personal suffering but also to high individual and societal costs (Kessler et al., 2008), which further emphasizes the need for effective treatments. Many treatment guidelines position cognitive-behavior therapy (CBT) as the treatment of choice for anxiety disorders (e.g., Chambless & Ollendick, 2001; Clark, 2011; Socialstyrelsen, 2010). Indeed, meta-analyses consistently show the positive effects of CBT for anxiety disorders in randomized controlled trials and in the clinical setting (Hofmann & Smits, 2008; Stewart & Chambless, 2009). At the same time, rates of clinical change also indicate that not all individuals benefit from CBT. For example, in their extensive review of meta-analyses, Hofmann and colleagues (2012) reported that 38%–77% of the anxiety patients responded to CBT. This implies that a significant proportion of individuals with anxiety disorders do not experience clinically significant relief through CBT. The improvement of existing treatments and the development of alternative treatment approaches are therefore warranted.

Kabat-Zinn and colleagues presented the first clinical trial on a novel 8-week group treatment program for anxiety disorders (Kabat-Zinn, Massion, Kristeller, & Peterson, 1992). The program introduced mindfulness meditation as the core treatment element. Mindfulness has been defined as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). Since the first trial, mindfulness meditation has been applied to the treatment of various mental and physical disorders, either as a stand-alone intervention—for example, in the form of Mindfulness-Based Stress Reduction (MBSR, Kabat-Zinn, 1990)—or as one part of multicomponent treatment approaches, such as Acceptance and Commitment Therapy (Hayes, Strosahl, & Wilson, 1999) and Dialectical Behavior Therapy (Linehan, 1993). In contrast to traditional CBT, mindfulness-based interventions do not target the reduction of anxiety symptoms directly. Instead, participants achieve a general way to relate to their inner and outer experiences by engaging in repeated meditation exercises. This approach includes a willingness to embrace distress and to not engage in experiential avoidance (Hayes & Wilson, 2003).

Several reviews have examined the efficacy of face-to-face mindfulness-based treatment approaches. For example, in a meta-analysis, Hofmann, Sawyer, Witt, and Oh (2010) evaluated mindfulness-based stand-alone interventions for a variety of mental and physical health conditions. In studies with diagnosed anxiety patients, effect sizes indicated a large reduction of anxiety symptoms (g = 0.97). Vøllestad, Nielsen, and Nielsen (2012) found similar results for stand-alone and integrated mindfulness-based interventions in the treatment of anxiety disorders. In 19 studies on different anxiety disorders, pre-post effect sizes averaged g = 1.08 and were stable at 3 months follow-up. Recently, two randomized controlled trials investigated the efficacy of MBSR as a transdiagnostic treatment approach in heterogeneous anxiety disorders (Arch et al., 2013; Vøllestad, Sivertsen, & Nielsen, 2011). Both trials included patients diagnosed with different anxiety disorders, for example, social anxiety disorder (SAD), panic disorder with or without agoraphobia (PD), and generalized anxiety disorder (GAD). Vøllestad et al. (2011) compared MBSR to a waitlist condition whereas Arch and colleagues (2013) compared MBSR to another bona fide treatment, cognitive-behavioral group therapy. Both trials reported good effects. MBSR proved superior to no treatment and was as effective as cognitive-behavioral group treatment.

The concept of mindfulness is intrinsically transdiagnostic. It advocates a general way of relating to experience and does not concentrate on the reduction of a specific set of symptoms (Bishop, 2002). Transdiagnostic approaches assume that individuals with mental disorders share specific behavioral and cognitive processes that contribute to the development and maintenance of mental disorders (Barlow, Allen, & Choate, 2004; Mansell, Harvey, Watkins, & Shafran, 2009). These processes include internal and external selective attention, attentional avoidance, interpretational bias, recurrent negative thinking, and avoidance and safety behaviors (Harvey, Watkins, Mansell, & Shafran, 2004). Unified transdiagnostic treatments are designed to specifically address these common dysfunctional processes. Mindfulness-based interventions advocate an open and nonreactive perception of events and teach the individual to process experiences without attempting to control, suppress, or avoid (anxiety related) sensations and situations (Roemer, Erisman, & Orsillo, 2009). As such, mindfulness-based therapies target symptomatic processes that occur across anxiety disorders and are therefore especially suited to treat anxiety transdiagnostically. Taken together,

mindfulness-based interventions seem to offer a valuable treatment option in the (transdiagnostic) treatment of anxiety disorders. As such, mindfulness-based interventions have the potential to broaden the spectrum of evidence-based treatments for anxious patients and to offer an alternative for the subset of patients who do not benefit from CBT.

A major concern in mental health care remains the limited access to evidence-based treatments and the low treatment rates. Only a minority of individuals with anxiety disorders seek and have access to evidence-based mental health treatment (Mackenzie, Reynolds, Cairney, Streiner, & Sareen, 2012; Roberge, Fournier, Duhoux, Nguyen, & Smolders, 2011). Low treatment rates are associated with the restricted availability of effective treatments (Wang et al., 2007) and other factors such as the fear of stigma (Gulliver, Griffiths, & Christensen, 2010). Internet-based interventions offer solutions to these barriers in treatment seeking. They combine the advantages of high availability, easy access, low cost, and anonymity (Andersson, 2009). Multiple randomized controlled trials have successfully evaluated cognitive-behavioral interventions for different anxiety disorders. Results are summarized in several meta-analyses and demonstrate the efficacy of Internet-based CBT for SAD, GAD, and PD (Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010; Boettcher, Carlbring, Renneberg, & Berger, 2013; Cuijpers et al., 2009; Reger & Gahm, 2009). Recently, unified transdiagnostic cognitive-behavioral treatment protocols have been tested and showed good effects in the treatment of heterogeneous anxiety disorders (Berger, Boettcher, & Caspar, 2013; Carlbring et al., 2011; Johnston, Titov, Andrews, Dear, & Spence, 2013). In these trials on unified approaches, rates of significant clinical change varied between 40%–60%. These proportions are similar to rates of improvement found for disorder-specific Internet-based treatments. Still, these proportions emphasize the importance of exploring alternative, transdiagnostic treatment approaches in Internet-based settings. To our knowledge, no study thus far has evaluated mindfulness treatment for anxiety disorders in the Internet-based setting. Two previous studies investigated Web-based mindfulness programs in nonclinical samples and reported positive results on the feasibility and the reduction of stress (Glück & Maercker, 2011; Krusche, Cyhlarova, King, & Williams, 2012). The current study compares a mindfulness treatment program to a discussion forum control group in patients with SAD, PD, GAD, or anxiety disorder not otherwise specified (ADNOS). Participation in an online discussion forum has previously been shown to be an adequate active control condition in Internet-based interventions (Andersson et al., 2011; Andersson, Carlbring, & Furmark, 2012; Carlbring et al., 2011). It was hypothesized that participation in the Internet-based mindfulness program would lead to greater changes in anxiety as well as in depression, insomnia, and quality of life than the participation in the control online discussion forum.

Method

PARTICIPANTS

The trial was registered at ClinicalTrials.gov (NCT01577290). The regional ethics committee of Umeå University approved the study protocol. Participants were recruited via advertisements in regional and national newspapers and on the project's study website (www.studie.nu). After registering with their e-mail address, participants obtained detailed information about the theoretical background, the goals and the design of the study, and were asked to give written informed consent. They were informed that the study aimed to compare a mindfulness-based treatment to a control condition and that participants randomized to the control group would receive access to the active treatment after post-assessment.

The selection of participants followed two steps. Participants were asked to fill out the outcome questionnaires. These included, among others, the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988), the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), and additional questions regarding current and past psychological or medical treatment for mental problems. Participants who indicated at least mild anxiety on the BAI (cutoff > 8) and who did not indicate severe depression according to the BDI-II (cutoff < 29) or suicidal ideation as assessed by the suicide item of the BDI-II (item 9 < 2) were then invited to take part in a diagnostic interview. The interview was conducted via telephone, a procedure with adequate psychometric properties (Crippa et al., 2008). Four advanced MSc clinical psychology students conducted the depression and anxiety disorders sections of the Structured Clinical Interview for DSM-IV Axis I Disorders (First & Gibbon, 2004). The interviewers had received training in using the interview. The SCID training included sample videos, role-plays, and supervised training interviews.

We applied the following inclusion criteria: (a) at least 18 years old, (b) access to the Internet, (c) meeting diagnostic criteria for a primary diagnosis of social anxiety disorder, panic disorder with or without agoraphobia, generalized anxiety disorder, or anxiety disorder not otherwise specified, (d) not participating in any other psychological treatment for the duration of the study, (e) no extensive prior

experience with mindfulness meditation, and (f) if on prescribed medication for anxiety/depression, dosage had to be constant for 3 months prior to the start of the treatment.

PROCEDURE

After pre-assessment, participants were randomly allocated to the mindfulness treatment group (MTG) or the discussion forum control group (CG) by an online true random-number service independent of the investigators. After randomization, participants of the MTG received access to a website where the mindfulness program was presented. They were asked to work with the mindfulness program daily for 6 days of the week for 8 weeks. Participants in the control group received access to an online discussion forum and were invited to take part in online discussions during 8 weeks. Participants in both groups received an automated e-mail at the end of Week 4, encouraging them to carry on with the assigned treatment. Primary and secondary outcome measures were administered over the Internet prior to the treatment, after the treatment at the end of Week 8, and, for participants of the MTG, at 6 months follow-up. Participants of the CG were offered the mindfulness program after post-assessment.

INTERVENTION

Internet-Based Mindfulness Treatment

At the core of the unguided, Internet-based mindfulness treatment program were brief, instructive audio files presenting mindfulness exercises (Schenström, 2010). Mindfulness exercises included instructions for sitting meditation, mindfulness movement, three different types of body scan, and four different forms of breathing anchor. The program was organized into eight modules. At the beginning, participants were presented with a 20-minute video that explained the concept of mindfulness and its relevance for anxiety disorders and introduced the eight modules of the program. The modules were as follows:

1. Stopping and Getting Started
2. Knowing Your Body
3. Increasing Your Concentration
4. Managing Your Thought Noise
5. Stretching Your Borders
6. SOAL: Stop, Observe, Accept, and Let Go
7. It Is What It Is
8. Sitting With Whatever Comes Up

In each module, mindfulness exercises were combined with brief psychoeducation and written instructions to apply the concept of mindfulness in daily life. Each module included 12 mindfulness exercises, each of which lasted 10 minutes, resulting in a total of 960 minutes (16 hours) of mindfulness exercises for the 8-week treatment period. Before each mindfulness exercise, participants were instructed to reflect on the purpose for the exercise. Participants were asked to complete one module each week and to conduct mindfulness exercises twice a day on 6 days of the week. Participants only gained access to the next module once they had completed the previous one.

Online discussion forum. Participants in the control group received access to a closed, anonymous, and supervised online discussion forum. Each week, a new topic was presented for discussion. All topics were related to anxiety or panic but were not therapeutic in nature. For example, topics included how participants perceived the health care provided for anxiety disorders, how they discussed anxiety problems with others, and how they perceived seasonal changes of mental health problems. These online dialogues were supervised but the investigators did not take active part in the discussions.

Outcome measures. Our primary outcome measure was the BAI, a 21-item self-report questionnaire that assesses the severity of somatic and cognitive anxiety symptoms. Items are scored on a 0–3 Likert scale and the total score ranges between 0–63 points. In addition, as secondary outcome measures, we administered the BDI-II, the Quality of Life Inventory (QOLI; Frisch, Cornell, Villanueva, & Retzlaff, 1992), and the Insomnia Severity Index (ISI; Morin, 1993). The BDI-II measures depression on 21 items, with a total score ranging between 0 to 63 points (0–3 Likert scale). The QOLI assesses the importance of (0–2 Likert scale) and satisfaction with (-3 to 3 Likert scale) 16 life domains on 32 items (total score -6 to 6). The ISI is a brief questionnaire that assesses insomnia on 7 items (0–4 Likert scale; total score 0–28). All outcome measures were administered online, a procedure that has demonstrated adequate psychometric properties for all applied instruments (Hedman et al., 2010; Lindner, Andersson, Öst, Carlbring, 2013; Thorndike et al., 2009, 2011). In the current sample, reliability estimates at pre-assessment were as follows: BAI: $\alpha = 0.82$, BDI-II: $\alpha = 0.82$, QOLI: $\alpha = 0.79$, and ISI: $\alpha = 0.86$.

Statistical analyses. All analyses on change in primary and secondary outcome measures were conducted as intention-to-treat analyses using a mixed models approach. Analyses were carried out in R Version 2.15 (R Development Core Team, 2010), and mixed models were fitted with NLME (Jose, Douglas, Saikat, Deepayan, & R Development Core Team, 2012). In this approach, main and

interaction effects are evaluated on the basis of their contribution to an increase of goodness of model fit (Field, Miles, & Field, 2012). The increase of fit is χ^2 -distributed. Within- and between-group effect sizes were calculated using Cohen's formula based on pooled standard deviations (Cohen, 1988).

Clinically significant change was calculated for the BAI for the completer sample according to the criteria suggested by Jacobson and Truax (1991). In order to facilitate comparison of the present findings with those of other studies, we adopted criteria for improvement and recovery from two previous trials (Vøllestad et al., 2011; Westbrook & Kirk, 2005). Reliable improvement or deterioration was defined as a pre-post change score of 10 points or more and recovery was defined as a post BAI score of 10 or less.

Results

A total of 91 participants met all inclusion criteria and were randomized to one of the two groups (see flow chart in Figure 1). Seven participants (7.7%) did not complete the outcome measures at posttreatment. Dropout rates did not differ between the two groups, $\chi^2(1) = 1.47$, $p = .267$. Ten participants in the mindfulness group (11%) failed to fill out self-report measures at 6-months follow-up-assessment.

Table 1 displays sociodemographic characteristics and Table 2 depicts pretreatment scores of the outcome measures for the two groups. There were no significant group differences at pretreatment on any demographic variable or outcome measure: all $\chi^2(1\text{-}3) < 2.33$, all $p > .31$; all $t(89) < 1.31$, all $p > .19$.

The computer automatically registered the amount of completed mindfulness exercises for the MTG. Participants in the mindfulness group completed on average 44 ($SD = 33.7$) out of 96 mindfulness exercises, which corresponds to an average of 7.3 hours of mindfulness practice during the 8-week intervention period. These time specifications can only be estimators of the real practice time. The program only recorded the amount of started exercises. It remains unknown whether the mindfulness exercises were not only started but also conducted for the full intended 10 minutes.

In both groups, participants were asked at post-assessment how satisfied they were with the received treatment. Answers ranged from 1 (*not at all satisfied*) to 5 (*very satisfied*). Participants of the mindfulness group were on average "satisfied" with the treatment ($M = 3.7$, $SD = 1.0$) whereas participants of the online forum control group were only "somewhat satisfied" ($M = 3.0$, $SD = 1.2$). This group difference in satisfaction was significant, $t(80) = 2.88$, $p < .01$.

CHANGE IN PRIMARY AND SECONDARY OUTCOMES

Means, standard deviations, and effect sizes for all four outcome measures in both groups are displayed in Table 2. The mixed models analysis on the BAI revealed that participants in the mindfulness group showed a larger decrease of anxiety from pre- to post-assessment than participants of the control group (Group × Time: $\chi^2[1] = 9.71$, $p = .002$). Pre-post effect sizes were large ($d = 1.33$) for the mindfulness group and moderate ($d = 0.76$) for the control group. The between-group effect size at post-assessment indicated a large group difference ($d = 0.99$). Results on the depression scale were similar. The mixed model analysis using the BDI as dependent variable showed a significant Time × Group interaction, $\chi^2(1) = 15.60$, $p < .001$. Participants of the active group indicated more improvement on depression scores from pre- to post-assessment than participants of the control group (between-group effect $d = 0.84$). Pre-post effect sizes were large ($d = 1.58$) in the mindfulness group and small ($d = 0.49$) in the control group. The mindfulness group also improved significantly more than the control group on the ISI. The mixed model analysis revealed that participants of the active group showed a larger decrease in insomnia from pre- to post-assessment than did participants of the control group (Time × Group: $\chi^2[1] = 5.77$, $p = .016$). Effect sizes indicated large improvements for the active group ($d = 0.82$) and small improvements for the control group ($d = 0.45$), as well as a small group difference at post-assessment ($d = 0.36$). The mixed model analysis on the QOLI also revealed a significant interaction effect of Time × Group, $\chi^2(1) = 6.68$, $p = .009$. Participants in the mindfulness group reported a moderate increase of life satisfaction ($d = 0.64$), whereas participants of the control group showed no change ($d = 0.04$). Group differences at post-assessment were small ($d = 0.37$).

Differences Between Diagnostic Groups

To examine whether the different diagnostic groups predicted or moderated primary treatment outcome, we entered diagnostic group as an additional independent variable in the mixed model on the BAI. Results indicated that although the different diagnostic groups showed different levels of anxiety across both assessment points and both treatment groups (main effect diagnostic group: $\chi^2[3] = 19.84$, $p < .001$), the specific anxiety diagnosis did not predict change in anxiety (Diagnostic Group × Time: $\chi^2[3] = 1.89$, $p = .596$) nor did it moderate the treatment effect (Diagnostic Group × Time × Treatment Condition: $\chi^2[6] = 6.83$, $p = .337$). In other words, in both treatment

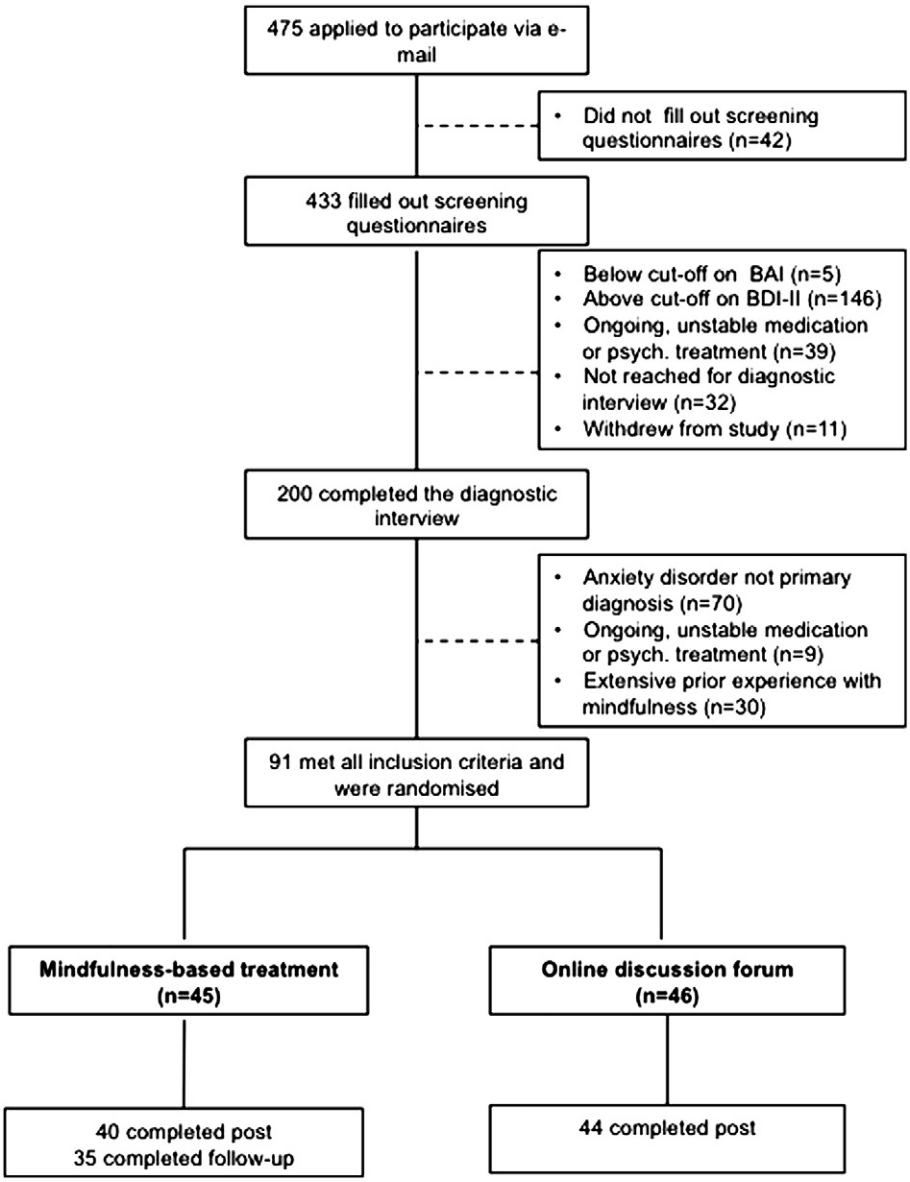

FIGURE 1 Flow of participants.

conditions, participants with PD, GAD, SAD, and ADNOS showed similar rates of anxiety change.

Psychotherapy Experience

To investigate the impact of former psychotherapy experience on treatment outcome, we included experience with psychotherapy (yes/no) as an additional independent variable into the mixed model analysis on the BAI. Results showed that the experience with psychological treatment did not influence change in anxiety scores across both treatment groups (Psychotherapy Experience × Time: $\chi^2[1] = 2.28$, $p = .131$). Participants with former experiences with psychotherapy showed similar rates of improvement as participants without such experiences. Differences in previous psychotherapy experience also did not lead to differential change rates of anxiety symptoms in the two treatment conditions (Psychotherapy Experience × Time × Treatment Condition: $\chi^2[2] = 2.12$, $p = .345$).

Amount of Exercises

We also examined whether the amount of completed mindfulness exercises predicted change in anxiety in the mindfulness treatment group (MTG). Amount of mindfulness exercises was entered as an independent variable into a mixed model within the MTG using the BAI at pre- and post-assessment as dependent

Table 1
Characteristics of Participants at Pre-Assessment

		Mindfulness group (N = 45)		Control group (N = 46)		Total (N = 88)	
		M	*SD*	*M*	*SD*	*M*	*SD*
	Age	37	8.9	40	11.5	38	10.3
		N	%	*N*	%	*N*	%
Sex	male	11	24.4	15	32.6	26	28.6
	female	34	75.6	31	67.4	65	71.4
Relationship status	married / in relationship	29	64.4	33	71.7	62	68.1
	single	16	35.6	13	28.3	29	31.9
Education	low	2	4.4	2	4.3	4	4.4
	medium	9	20.0	13	28.3	22	24.2
	high	34	75.6	31	67.4	65	71.4
Former psych. treatment	yes	28	62.2	28	60.9	56	61.5
	no	17	37.8	18	39.1	35	38.5
Medication	never	22	48.9	27	58.7	49	53.9
	former	9	20.0	9	19.6	18	19.8
	ongoing	14	31.1	10	21.7	24	26.3
Primary diagnosis	GAD	11	24.4	6	13.0	17	18.7
	SAD	13	28.9	13	28.3	26	28.6
	PD	13	28.9	17	37.0	30	33.0
	ADNOS	8	7.8	10	21.7	18	19.8
Secondary diagnosis	Any Disorder	9	20.0	14	30.4	23	25.3
	Affective Disorder	4	8.9	3	6.5	6	6.6
	Any Anxiety Disorder	5	11.1	11	23.9	16	17.6
	PD	4	8.9	2	4.4	6	6.6
	SAD	1	2.2	4	8.7	5	5.6
	GAD	0	0.0	5	10.9	5	5.6

Note. GAD = Generalized Anxiety Disorder; SAD = Social Anxiety Disorder; PD = Panic Disorder With or Without Agoraphobia; ADNOS = Anxiety Disorder Not Otherwise Specified.

variable. Results showed that the amount of exercises did not predict treatment outcome (Time × Exercises Completed: $\chi^2[1] = 2.54$, $p = .111$).

CLINICAL SIGNIFICANCE OF CHANGE

Table 3 depicts the rates of clinical significant change on the primary outcome measure BAI at post-assessment for the two groups (completer sample). Sixteen participants (40%) of the mindfulness group met the criteria of improvement and recovery compared to 4 participants (9%) in the control group. This difference in response rates was significant, $\chi^2(1) = 11.04$, $p = .002$.

MAINTENANCE OF TREATMENT EFFECTS

At 6-month follow-up, the control group had received access to the mindfulness treatment program, so analyses are based on the MTG only. Means and standard deviations at 6-month follow-up are included in Table 2. Paired *t*-tests from pre- to follow-up assessment showed that there was a significant decline in anxiety scores (BAI: $t[34] = 8.54$, $p < .001$, $d = 1.44$). Similarly, on secondary outcome measures, participants of the MTG showed a significant reduction of symptoms of depression and insomnia (BDI-II: $t[34] = 5.89$, $p < .001$, $d = 1.00$; ISI: $t[34] = 4.77$, $p < .001$, $d = 0.82$) and a significant improvement in quality of life from pre- to follow-up assessment ($t[34] = -3.12$, $p = .004$, $d = 0.53$). Differences between post and 6-month follow-up indicated stable treatment results for three out of the four outcome measures. There were no significant post- to follow-up differences for anxiety, $t(34) = -0.95$, $p = .347$, insomnia, $t(34) = -1.97$, $p = .057$, and quality of life, $t(34) = 1.67$, $p = .104$. Results showed a significant increase of depressive symptoms from post- to follow-up assessment, $t(34) = -2.18$, $p = .036$.

Discussion

The current trial aimed to evaluate the efficacy of an Internet-based mindfulness treatment program for persons with anxiety disorders. Pre-post change scores as well as the comparison to an active control condition indicated that participants of the mindfulness program benefitted substantially from the treatment and experienced a significant decrease of anxiety symptoms. Participants of this group also

Table 2
Means, Standard Deviations and Cohen's *d* for Primary and Secondary Outcome Measures

		Mindfulness group			*Control group*					
		M	*SD*	*within (95%CI)*	*M*	*SD*	*within (95%CI)*	*Between (95%CI)*	*Mixed models*	
BAI	pre	24.4	8.6		26.7	8.5			*time*	$\chi^2(1) = 58.18$, $p < .001$
	post	11.8	7.8	1.33 (0.90 - 1.76)	20.8	10.0	0.76 (0.42 - 1.09)	0.76 (0.42 - 1.09)	*group*	$\chi^2(1) = 9.83$, $p = .002$
	follow-up	12.4	6.7	1.44 (0.96 - 1.92)					*time x group*	$\chi^2(1) = 9.71$, $p = .002$
BDI-II	pre	16.4	7.0		16.2	7.3			*time*	$\chi^2(1) = 45.79$, $p < .001$
	post	6.5	4.8	1.58 (1.11 - 2.04)	12.6	9.4	0.49 (0.17 -0.80)	0.49 (0.17 -0.80)	*group*	$\chi^2(1) = 4.67$, $p = .031$
	follow-up	9.6	8.2	1.00 (0.58 - 1.40)					*time x group*	$\chi^2(1) = 15.60$, $p < .001$
ISI	pre	12.2	5.7		11.3	6.1			*time*	$\chi^2(1) = 31.37$, $p < .001$
	post	7.3	4.7	0.82 (0.46 -1.17)	9.2	6.3	0.45 (0.14 - 0.76)	0.45 (0.14 - 0.76)	*group*	$\chi^2(1) = 0.10$, $p = .746$
	follow-up	8.4	4.6	0.81 (0.42 - 1.18)					*time x group*	$\chi^2(1) = 5.77$, $p = .016$
QOLI	pre	1.2	1.3		1.6	1.4			*time*	$\chi^2(1) = 6.54$, $p = .011$
	post	1.9	1.4	0.64 (0.30 - 0.98)	1.3	1.6	0.04 (-0.25 - 0.34)	0.04 (-0.25 - 0.34)	*group*	$\chi^2(1) = 0.50$, $p = .479$
	follow-up	1.7	1.4	0.53 (0.17 - 0.88)					*time x group*	$\chi^2(1) = 6.68$, $p = .009$

Note. BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory; ISI = Insomnia Severity Index; QOLI = Quality of Life Inventory.

achieved substantial reductions in symptoms of depression and insomnia, which are very common comorbid conditions among individuals with anxiety disorders. Most improvements were stable at 6-month follow-up with the exception of changes in depressive symptoms. Overall, the present study supports previous results achieved in face-to-face settings on mindfulness as an effective transdiagnostic treatment approach in heterogeneous anxiety disorders (Arch et al., 2013; Vøllestad et al., 2011). In contrast to the present study, Arch and colleagues treated more severely disturbed patients in a more clinically representative setting and reported only moderate changes on self-report measures. The selection and recruitment of participants in the study of Vøllestad et al. (2011), on the other hand, was very similar to the current randomized controlled trial and effects on primary and secondary measures, as well as clinical change rates, were comparable. Results of the present study are also in line with findings of recent meta-analyses on mindfulness-based treatments in anxiety disorders (Hofmann et al., 2010; Vøllestad et al., 2012). Similar to the current results, Vøllestad and colleagues (2012) reported large average

Table 3
Rates of Significant Clinical Change at Post-Assessment

	Mindfulness group (N = 40)		Control group (N = 44)		
	N	*%*	*N*	*%*	test statistics
improved	28	70.0	14	31.8	$\chi^2(2) = 14.31$, $p < .001$
no change	11	27.5	30	68.2	
deteriorated	1	2.5	0	0.0	
recovered	20	50.0	7	15.9	$\chi^2(1) = 11.16$, $p = .001$
not recovered	20	50.0	37	84.1	
improved and recovered	16	40.0	4	9.1	$\chi^2(1) = 11.16$, $p = .001$

reductions in depression and anxiety and moderate improvements in quality of life through stand-alone and combined face-to-face mindfulness treatments. In conclusion, mindfulness exercises delivered in face-to-face settings or remotely via the Internet seem to yield similar changes in symptoms. The remote delivery does not seem to lessen the efficacy of mindfulness interventions. This is surprising as some differences in the setting are prone to affect common mechanisms of change. The most salient difference constitutes the lack of contact to a clinician and to other patients in the Internet setting. As Baer, Carmody, and Hunsinger (2012) point out, the contact with a warm and empathetic group leader as well as the sharing with fellow participants very likely stimulate therapeutic changes in face-to-face mindfulness programs, above and beyond the effects elicited by more specific mechanisms of change. Accordingly, Malpass and colleagues (2011), who describe the therapeutic process in mindfulness treatments from the participants' point of view, highlight the perceived importance of the group as a therapeutic factor. The proposed specific therapeutic factor in mindfulness-based interventions is an increase of mindfulness. An increase of mindfulness has repeatedly been associated with the reduction of symptoms (e.g., Bränström, Kvillemo, Brandberg, & Moskowitz, 2010; Carmody & Baer, 2008; Vøllestad et al., 2011). Baer and colleagues demonstrated that an increase in facets of mindfulness, such as observing, nonreactivity, acting with awareness, and nonjudging, preceded and mediated changes in stress in an MBSR program. While the beneficial effect of an increase of mindfulness very likely also applies to Internet-based mindfulness treatments, the effects of more common mechanisms of change, such as the therapeutic relationship or group therapeutic factors, do not apply to an Internet-based intervention. In the present study, participants practiced mindfulness without any contact or support from clinicians or fellow participants. This also applies to two previous Internet-based mindfulness studies in nonclinical samples (Glück & Maercker, 2011; Krusche et al., 2012). In effect, the good outcomes of unguided Internet-based mindfulness studies at least partly question the necessity of interpersonal common factors in mindfulness treatments.

A second important difference between the current Internet trial and previous trials constitutes the intensity of treatments. The applied Internet-based program was restricted to 20 minutes of daily mindfulness exercise. The MBSR treatment program encompasses 30 hours of group treatment paired with instructions to train in mindfulness daily for 45 to 60 minutes (Kabat-Zinn, 1990). Similarly, in mindfulness-based cognitive therapy (Segal, Williams, & Teasdale, 2012), patients spend 24 hours in group treatment and train an additional 45 to 60 minutes per day at home. Unfortunately, most clinical trials on mindfulness-based interventions failed to document to which extent patients actually adhered to these extensive homework assignments. As an exception, Vøllestad et al. (2011) reported that their participants practiced mindfulness for, on average, 34 minutes a day. This constitutes a vast difference to the 7 minutes of mindfulness practice per day found in the current trial. As both treatment protocols yielded comparable outcomes in similar patient populations, these findings suggest that treatment intensity does not crucially affect treatment outcome in mindfulness-based interventions. Indeed, reviews on mindfulness interventions found no or equivocal results on the relationship between number of treatment sessions/amount of homework exercise and treatment outcome (Toneatto & Nguyen, 2007; Vettese, Toneatto, Stea, Nguyen, & Wang, 2009; Vøllestad et al., 2012). In the present trial, the association between completed mindfulness exercises and change in anxiety was weak ($r = .26$, $p = .114$). Also, the good results of the present study were paired with a rather low adherence. Participants completed on average only half of the treatment protocol. There is yet no empirical data on the necessary and sufficient amount of mindfulness practice. Future studies should investigate dose-response relations in Internet as well as in face-to-face mindfulness-based interventions.

Previous research on transdiagnostic Internet-based treatments for anxiety disorders found that tailored or unified cognitive-behavioral programs can be effective in the reduction of anxiety symptoms (Berger et al., 2013; Carlbring et al., 2011; Johnston et al., 2011). The reported between- and within-group effect sizes of the current trial are comparable to those achieved through these CBT trials. Also, the attrition rate of 8% in the current trial ranges well within the proportions reported in online CBT trials (4%–10%; Berger et al., 2013; Carlbring et al., 2011; Johnston et al., 2011). When comparing ratings of satisfaction with the received treatments, participants in the current mindfulness trial seem a bit less satisfied (average of 4 on a 1–5 scale) than participants in the two previous transdiagnostic CBT trials that reported satisfaction ratings (average of 3–4 on a 1–4 scale; Berger et al., 2013; Johnston et al., 2011). Overall, the Internet-based mindfulness treatment of anxiety disorders seems equally effective and acceptable as Internet-based CBT approaches.

Although totally different in content, the applied Web-based mindfulness program and online CBT

programs share some common features that have been found to be associated with good therapeutic outcome. For example, participants in both types of Internet treatments underwent the same extensive diagnostic process that has been found to promote adherence and therapeutic change (Barak, Hen, Boniel-Nissim, & Shapira, 2008; Boettcher, Berger, & Renneberg, 2012). Furthermore, participants in both Internet treatments completed their therapy within a clear deadline, an additional characteristic of Internet-based treatments that has been found to be associated with good outcome (Nordin, Carlbring, Cuijpers, & Andersson, 2010). These shared features and the comparable good results suggest that some characteristics of the Internet setting per se contribute to therapeutic change, possibly by the stimulation of positive outcome expectations (Boettcher, Renneberg, & Berger, 2013).

LIMITATIONS AND FUTURE RESEARCH

The current trial is, to our knowledge, the first to evaluate an Internet-based mindfulness treatment program for anxiety disorders. As such, it concentrated on the examination of efficacy. Nonetheless, the lack of information regarding the proposed mechanism of change in mindfulness treatments, the increase of mindfulness, is the central limitation of the present study. Future Internet-based studies should assess likely common and specific agents of change on a regular basis and relate these to changes in different outcome domains. A second limitation of the present design constitutes the lack of a diagnostic interview at post-assessment. Even though rates of clinical change are an indicator of how many participants benefitted from the treatment, a clinician-rated reevaluation of diagnostic status would have been helpful to estimate the effects of this treatment on remission and comorbidity (Johnston et al., 2013). To this end, the administration of disorder-specific self-report questionnaires also would have been helpful. The restriction to use the BAI as primary outcome measure makes it harder to compare the current trial to disorder-specific studies. Furthermore, as the BAI mainly focuses on the assessment of somatic anxiety symptoms, it may not adequately reflect changes in cognitive symptoms of anxiety, such as worrying in GAD (Leyfer, Ruberg, & Woodruff-Borden, 2006). A further limitation of the present study lies in the assessment of treatment adherence. We only assessed how many exercises were initiated and were unable to verify whether and for how long these exercises were performed. Clearly, the present study needs replications and can only be considered as a first step towards the establishment of online mindfulness programs in the treatment of anxiety disorder. In order to estimate the comparative efficacy of mindfulness online treatments, future studies should apply more carefully controlled comparison groups. One limitation of the current trial is the failure to assess the engagement of the participants in the online discussion forum control group. We do not know how much time the participants spent in the forum and how actively they participated in the discussions. Moreover, participants of the control group were informed beforehand that they would receive the mindfulness treatment after post-assessment, perhaps inadvertently producing a wait-list quality to the control group as some participants may have ignored the offer of the online discussion group and waited for the active treatment. This makes it hard to interpret the between-group effect sizes. Nevertheless, the results of the current trial suggest that an unguided mindfulness program can be as effective as established Internet-based CBT programs. Mindfulness-based treatments could form an alternative to existing online programs. They could offer a valid choice for persons seeking treatment for anxiety disorders in general and for patients who do not respond to CBT in particular. Mindfulness and CBT treatments differ substantially in the demands they pose on participants. Both treatment approaches are participatory and ask the patient to engage actively in the therapeutic process. However, whereas mindfulness treatments request the patient to follow repeated meditation instructions, CBT protocols ask the patient to actively engage in varying exercises (e.g., dysfunctional thoughts protocol, behavioral experiments). In direct comparisons of mindfulness and CBT treatments, future studies should investigate patient characteristics and preferences that are potentially associated with differential treatment outcome. In accordance with face-to-face multicomponent mindfulness interventions, mindfulness exercises could also complement cognitive-behavioral treatment protocols. Future studies should seek to explore reasonable ways to combine both treatment approaches in the Internet-based setting and empirically evaluate the potential benefits of combined treatments.

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Conflict of Interest Statement

Five of the six authors have no competing interests to report. Dr. Ola Schenström has founded a company that, among other things, markets online mindfulness products.

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