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ORIGINAL PAPER

Treating Depression Mindfully in a Day Hospital: a Randomised Controlled Pilot Study

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Abstract

Objectives Recent preliminary evidence suggests that mindfulness-based programmes may be beneficial in the treatment of patients suffering from current depression. Due to the heterogeneity of patients with this diagnosis, a specialisation in treatment concepts for subgroups of patients may be beneficial.

Methods This randomised controlled pilot study investigated the effectiveness of an eight-week mindfulness-based day hospital treatment for patients with current depression and work-related conflicts (MDT-DH) under naturalistic conditions. Eighty-one currently depressed patients with work-related conflicts were randomly assigned to either MDT-DH (including personalised psychopharmacological treatment if necessary) or a waitlist condition including a psychopharmacological consultation (PCC). Outcomes were assessed at post-treatment and at 8-month follow-up. The primary outcome was depression severity (Beck Depression Inventory) at post-treatment. Secondary outcomes were work ability (Work Ability Index) and mindfulness (Kentucky Inventory of Mindfulness Skills).

Results A multilevel analysis revealed that compared with patients in PCC, patients in the MDT-DH group showed a greater reduction in depression severity, higher work ability and heightened levels of mindfulness after 8 weeks than patients in the PCC group. These improvements were stable during the 8-month follow-up period.

Conclusions Findings of the present pilot study suggest that a treatment concept involving intensive training in mindfulness can be successfully established in a day hospital and leads to clinically meaningful reductions in depression severity and increases in work ability in patients suffering from current depression. The generalisability of the findings may be limited due to small sample size, selective patient group and study design.

Keywords Mindfulness · RCT · Depression · Work ability · Work-related stressors · Day hospital

Major depression is a common mental disorder and one of the leading causes of disability worldwide (World Health Organization 2017). There is pronounced heterogeneity in patients with a diagnosis of depression (Ferrari et al. 2013) and it is well known that work-related psychosocial factors can play a major role in the development and maintenance of chronic stress, impaired functioning and depression (Bonde 2008; Melchior et al. 2007; Netterstrøm et al. 2008; Siegrist 2008). A systematic review including a meta-analysis found moderately strong evidence for lack of decision latitude, job strain (i.e. high psychological demands and low decision latitude) and bullying to be related to depressive symptoms (Theorell et al. 2015). Further limited evidence was found for low support, effort reward imbalance, unfavourable social climate, conflicts with superiors and colleagues, job insecurity and long working week (Theorell et al. 2015). High job strain is also associated with an inability to 'unwind' physiologically

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after work and increased rumination (Cropley and Millward Purvis 2003). Against the background of these stressors, preventing over-engagement with work, learning to let go (e.g., of problems, conflicts or perfectionism) and increasing awareness of one's organismic states and needs (e.g., tiredness, hunger or thirst) and current stress level seem to be important in coping with work-related stressors and resulting depressive symptoms.

In this respect, patients suffering from work-related stress and resulting depression may particularly benefit from a mindfulness-based programme (MBP). Mindfulness refers to an originally Buddhist principle and can be defined as focusing one's attention on the present moment and simultaneously adopting an attitude of acceptance and non-judgement (Kabat-Zinn 1994). The present moment awareness can include body sensations, emotional reactions, cognitions and perceptual experiences. Adopting an attitude of openness towards and acceptance of one's experience is critical, because it enables a person to experience the present moment with a curious, detached and non-reactive orientation (Creswell 2017). This non-judgmental attention can foster a dispassionate state of self-observation (Bishop et al. 2004). In this non-striving attitude an 'inner space' between the individual's perception of events and their automatic, habitual patterns of reactivity ('autopilots') can be attained, which is thought to enable a more reflective as opposed to reflexive 'inner response' to events (Bishop et al. 2004). Indeed, experimental research has supported the idea that mindfulness disrupts otherwise automatically operating processes and impulses (Papies et al. 2012), improves attentional functions (Moore and Malinowski 2009) and facilitates de-automisation which further cultivates adaptive self-regulation (Kang et al. 2013).

The use of MBPs in the treatment of a variety of psychological problems is well established (Creswell 2017; Khoury et al. 2013). While mindfulness-based stress reduction (MBSR; Kabat-Zinn 1982) has been shown to be beneficial for a range of psychological and physical conditions (Bohlmeijer et al. 2010; Creswell 2017), mindfulness-based cognitive therapy (MBCT; Segal et al. 2002, 2013) is recognised as a relapse prevention programme for depression (Creswell 2017; MacKenzie et al. 2018). A meta-analysis of randomised trials of manualised MBCT for relapse prevention in recurrent depression comparing MBCT with non-MBCT treatment (including usual care) showed that patients receiving MBCT had a reduced risk of depressive relapse within a 60-week follow-up period, compared with those who did not receive MBCT. Furthermore, comparisons with active treatments suggest a reduced risk of depressive relapse within a 60-week follow-up period (Kuyken et al. 2016). Extending this line of research, preliminary results suggest that mindfulness-based programmes are also effective for patients suffering from current depression (Creswell 2017; Hofmann et al. 2010; Kenny and Williams 2007; Strauss et al. 2014; Van Aalderen et al. 2012) and are helpful in the context of work-related stressors and coping styles (Good et al. 2016; Virgili 2015).

The development of a mindful attentional focus on the present moment and a non-judgmental, accepting and detached view of one's thoughts may be especially helpful for patients suffering from work-related depression. First, this is assumed because research has shown that ruminative patterns which exacerbate and prolong distress and depression by interfering with effective problem solving and instrumental behaviour (Nolen-Hoeksema et al. 2008) are not only typical in depression in general but also in work-related depression specifically (Cropley and Millward Purvis 2003; Querstret and Cropley 2012). Together with reductions in cognitive and emotional reactivity, changes in rumination have been shown to be mechanisms underlying the efficacy of MBPs (Gu et al. 2015). As such, mindfulness can help patients to notice and regulate maladaptive thoughts (e.g., 'I cannot stop until the work is done.'), emotional responses (e.g., fear of failure),and automatic behaviours (e.g., working until exhaustion sets in), each of which appear to be particularly relevant in the context of work-related depression. Learning how to monitor experience with acceptance, in particular, can foster stress resilience and coping under stress (Creswell 2017). Second, mindfulness practice, with its focus on increasing body awareness, might help people get in contact with their organismic states and needs (Hölzel et al. 2011) and restore their sense of presence and agency in the world (Farb et al. 2015). Being aware of organismic states and needs (e.g., hunger and thirst, tiredness, excitement) and self-knowledge are basic requirements for successful self-regulation (Carlson 2013; Vago and David 2012). For example, being unaware of tiredness and exhaustion and a need for rest will probably prevent taking action steps (e.g. pausing, reducing workload) to restore organismic states. Third, being mindful of thoughts and emotions in an open and non-judgmental way may facilitate a greater sense of clarity with regard to one's values, which may in turn result in self-congruent behaviours (Carlson 2013; Keng et al. 2011; Levesque and Brown 2007). For example, research has shown that higher levels of self-reported mindfulness are associated with greater engagement in valued behaviours and interests (Brown and Ryan 2003), less ambivalence (Haddock et al. 2017) and greater ability to engage in goal-directed behaviour when emotionally upset (Baer and Krietemeyer 2006). This might enable individuals in the work context to better orient themselves towards important and valued goals.

There are a variety of evaluated occupational stress prevention and intervention programmes available for non-clinical target groups (e.g., Aikens et al. 2014; Ivancevich et al. 1990; Joyce et al. 2016; Van der Klink et al. 2001). However, psychotherapeutic interventions with a focus on work-related attitudes and behaviour patterns for patients currently suffering from depression are still rare in routine clinical care (e.g., Beutel et al. 2006; Koch et al. 2006; Meyer et al. 2016). This is

surprising, as the most prominent advantage of a specialised treatment concept is the possibility to tailor the treatment to the needs of the specific group of patients. Specifically because work-related experiences, conflicts and demands are addressed, patients may choose to participate in the treatment, which could lead to high commitment, low dropout rates and higher overall outcome (Zeeck et al. 2013). Moreover, to the best of our knowledge, there is no research on high-intensity interventions (i.e., inpatient or day hospital) integrating mindfulness as a core treatment principle. Yet, a mindfulness-based programme in a day hospital setting, in particular, could offer several advantages compared with an inpatient or outpatient setting. A day hospital is conceptually similar to a complex inpatient treatment setting with the difference that patients return home in the evenings and for the weekends, leading to lower costs than full-time hospitalisation (Zeeck et al. 2013). This setting offers the additional benefit of allowing for the regular transfer and testing of skills in patients' daily lives during evenings and weekends. While spending a significant amount of time in the therapeutic milieu, patients continue to have meaningful contact with family and their social environment and are able to practice their new abilities, strategies or behaviour and reflect new insights with their partners and friends. In comparison with regular MBPs, a day hospital offers several hours of daily treatment in a group setting over the course of 8 weeks and allows patients to develop new experiences away from the stress of work. More importantly, it offers a much more intense period of treatment and mindfulness practice than could be offered in outpatient treatment settings. Consequently, larger doses may produce larger effects (Creswell 2017). Finally, a day hospital setting might be especially suited to assisting patients to apply mindfulness to everyday stressors and to develop effective coping because, in addition to high doses of formal mindfulness training, it can offer treatment components specifically targeted to transferring mindfulness into everyday life.

Based on the foregoing reasoning, the aim of the present randomised controlled pilot study was to test the effectiveness of a *mindful depression treatment in a day hospital* (MDT-DH) under naturalistic conditions. The day hospital intervention was specifically developed for the treatment of patients suffering from a current episode of depression and work-related conflicts and was integrated in the regular primary care system. As a psychiatric department, patients also received medical treatment based on the German guidelines for the treatment of depression (National Guideline for Depression DGPPN 2015) if necessary and desired. We expected that the intensive, mindfulness-based treatment concept in a day hospital would produce large effects, compared with a waitlist condition which included a psychopharmacological consultation (based on the German guidelines for the treatment of depression to ensure consistency across conditions in the type of medication used), in reducing depression severity, promoting mindfulness and improving work ability.

Method

Participants

Participants were recruited through the regular admission process for the day hospital in the psychiatric department of the Asklepios Klinikum Hamburg. Eligible participants were patients with a current diagnosis of moderate or severe depression and self-reported work-related stressors as the main reason for their current depressive episode. Exclusion criteria were as follows: bipolar disorder, a history of schizophrenia or schizoaffective disorder, an organic mental disorder, a comorbid borderline personality disorder, eating disorder, or substance abuse. The sample was 55.6% male, with a mean age of 45.48 years ($SD = 8.54$; range 27–61) (see Table 1 for descriptive statistics).

Procedure

This study was designed as a single-centre randomised controlled trial comparing an eight-week mindful depression treatment in a day hospital setting (MDT-DH) to a psychopharmacological consultation waitlist condition (PCC). We chose the PCC to control for time effects and effects attributable to psychopharmacological treatment. Participants were assessed over the course of 8 weeks, either during their treatment in the day hospital or during the waiting period. In order to investigate the stability of the treatment effects, participants in the MDT-DH condition were additionally assessed 8 months after end of treatment. All study procedures were approved by the Ethics Committee of the University of Hildesheim. We additionally obtained research governance approval from the local primary care health board, the Hamburg Medical Chamber. The trial was retrospectively registered with the Deutsches Register Klinischer Studien (German Registry of Clinical Studies), No. DRKS00006314, and conducted and reported in accordance with CONSORT guidelines (Moher et al. 2012).

Study participants were recruited from February 2014 until June 2015 through the regular admission process of the day hospital (see Online Resource 1 for a description of the admission process). Patients were either self-referred after finding information on the treatment on the internet, were referred to the day hospital by their general practitioners, psychiatrists or psychologist or were referred by health counsellors at work, with reference to the specialised treatment concept. The online or flyer-based treatment description explicitly referred to the treatment of current depression which is maintained by work-related stressors and conflicts. By clearly stating its therapeutic specialisation, the day hospital attracted patients seeking therapeutic help with this specific focus. Due to high demand and limited treatment capacity of ten patients per month in the day hospital, the regular waiting

Table 1 Sample characteristics of the patients in PCC and MDT-DH at baseline and follow-up assessment

Characteristic	Baseline assessment			Follow-up assessment		
	PCC ($n = 34$)	MDT-DH ($n = 47$)	p value	MDT-DH ($n = 33$)	Non-completers[d] ($n = 12$)	p value
Age, *M* (SD)	44.09 (8.95)	46.49 (8.19)	0.55[a]	46.55 (7.39)	47.33 (10.40)	0.78[a]
Male sex, *n* (%)	19 (55.9)	26 (55.3)	0.96[b]	19 (57.6)	7 (58.3)	0.96[b]
Highest education level, *n* (%)			0.06[b]			0.30[b]
Secondary education	18 (52.9)	23 (48.9)		14 (42.4)	7 (58.3)	
University-entrance diploma	16 (48.1)	24 (51.1)		19 (66.7)	5 (41.7)	
Marital Status, *n* (%)			0.58[b]			0.34[b]
Single	3 (8.8)	9 (19.1)		4 (12.1)	3 (25.0)	
Steady relationship	9 (26.5)	9 (19.1)		7 (21.2)	1 (8.3)	
Married	22 (52.9)	24 (51.1)		18 (54.5)	6 (50.0)	
Divorced, widowed	4 (11.8)	5 (10.6)		3 (9.1)	1 (8.3)	
Work status, *n* (%)			0.89[b]			0.36[b]
Employed	32 (94.1)	43 (91.5)		31 (93.9)	10 (83.3)	
Self-employed	1 (2.9)	1 (2.1)		1 (3.0)	0 (0.0)	
Seeking work	1 (2.9)	3 (6.4)		1 (3.0)	2 (16.7)	
Subtypes of depression, *n* (%)			0.81[b]			0.28[b]
First episode	19 (55.9)	25 (53.2)		16 (48.5)	8 (66.7)	
Recurrent depression [c]	15 (44.1)	22 (46.8)		17 (51.5)	4 (33.3)	
Any Axis II morbidity, *n* (%)	16 (47.1)	18 (38.3)	0.43[b]	12 (36.4)	4 (33.3)	0.85[b]
Consulting psychiatrist, *n* (%)	14 (41.2)	23 (48.9)	0.48[b]	16 (48.5)	7 (58.3)	0.56[b]
Psychotherapy experience, *n* (%)	11 (32.4)	22 (46.8)	0.19[b]	17 (51.5)	5 (41.7)	0.56[b]
Mindfulness experience, *n* (%)	2 (5.9)	8 (17.0)	0.13[b]	5 (15.2)	3 (25.0)	0.45[b]

PCC, Psychopharmacological Consultation Control group; *MDT-DH*, Mindful Depression Treatment in a Day Hospital; non-completers, patients in MDT-DH who did not complete follow-up assessment

[a] By independent *t* test

[b] By χ^2 test

[c] Previous episodes stated by patients in diagnostic SCID interview

[d] MDT-DH patients who completed post-assessment yet did not take part in follow-up assessment

period for admission to treatment was 10 weeks (between being able to register for treatment and entering into treatment). To manage the high demand, a monthly information session for individuals interested in the treatment was established. During this information session, the focus of the treatment was again stated, and prospective participants were screened for a fit with the treatment concept (i.e., current depression and work-related stressors). During the study period, we added a study information module to the monthly session where we presented the current trial. Within this study information module, all persons interested in the study were fully informed of the process, duration and time investment required.

After expressing interest in the study, each participant signed a written consent, was given a randomly designed pseudonym and was listed for the next study cohort. Pseudonyms were emailed to a statistician at the University of Hildesheim who was not otherwise involved in the study, who randomly assigned participants to either the MDT-DH or the PCC condition of each cohort. To ensure that the diagnostic information was up to date at the first assessment, diagnostic eligibility of participants in each condition was determined with the Structured Clinical Interview for DSM-IV for depression (SCID; First et al. 1997; German version: Wittchen et al. 1997) immediately before the participants were due to start their first online assessment. While participants were aware of their group assignment, assessors conducting the SCID interviews were not aware of the participants' assignment. The diagnostic SCID interviews were carried out by raters who were not part of the treatment team. All raters were psychology students (master's programme) or graduates and received intense training in SCID interviews prior to the study by an experienced SCID rater and clinician. If in doubt, each rater was able to receive supervision from the head clinician (psychiatrist) of the day hospital. All participants, after meeting inclusion criteria, were asked to take part in the first online self-report assessment. It should be noted that because of the limited capacity of ten patients in each treatment cohort,

limited staff resources and other practical constraints in the naturalistic treatment setting (e.g., one patient's cancellation of treatment participation at short notice and the subsequent elevation of another patient from the waiting list), we aimed to maximise trial participation in each cohort and adjusted the randomisation ratio for each cohort throughout the trial.

Data collection took place over the course of 22 months, from April 2014 until February 2016 (see Online Resource 1 for the data collection process). All outcomes were assessed at baseline and post-treatment. Depression severity was also assessed in the middle of the treatment. The primary outcome was depression severity at post-treatment. In MDT-DH further data was collected at follow-up 8 months after post-treatment. Please note that further online self-report assessments and separate computer-based assessments were administered in a subsample of this study. The results were not relevant to the current study aims and are reported elsewhere (Remmers et al. 2017; Remmers et al. 2018). Two additional secondary outcomes (self-compassion and work-related behavioural and experiential patterns) were measured, which will also be presented elsewhere.

The current study includes data from 13 cohorts with 81 participants who were willing to participate and met the inclusion criteria. In the MDT-DH group, 48 patients participated in the study during the clinical treatment and three patients (6.3%) dropped out of the study (but continued the MDT-DH treatment), one of them without any baseline assessment (see Fig. 1 CONSORT diagram). None of the participants in either MDT-DH or PCC dropped out of the day hospital treatment. In the PCC group, 34 participants took part, of which two (5.9%) dropped out of the study but still wanted to be admitted to treatment after the waiting period. All dropouts during the study, irrespective of the group condition, stated that they felt overburdened with the time and concentration effort necessary to conduct the online assessments. In the MDT-DH group, 45 (93.7%) patients completed the assessments from baseline to post-assessment and in the PCC group, 32 participants (94.1%) provided complete assessments. Eight months after end of treatment, 33 patients (73.3%) within the MDT-DH group completed the follow-up assessment. Patients who did not complete the follow-up in the MDT-DH did not respond to enquiries. Consequently, we were unable to assess the reasons for non-completion.

Mindful Depression Treatment in a Day Hospital The psychiatric day hospital was established in 2009 as part of the primary care and health system in Hamburg. MDT-DH followed a structured and intense eight-week treatment concept in which the cultivation of a mindful mind-set (i.e. practicing focusing one's attention on the here-and-now and adopting an accepting, non-judgmental attitude) was the basis of the therapeutic rationale. The focus, throughout the treatment, was on coping with work-related conflicts, resulting stress and interpersonal situations in which patients learned to apply a mindful mind-set (e.g., adopting a non-judgmental attitude when facing conflicting interpersonal interests as opposed to automatically reacting with anger). At the heart of MDT-DH was the daily practice of formal (sitting meditation, 25 min) and informal mindfulness (e.g., mindful bodywork such as yoga or qigong, for a minimum of 50 min daily). There were also two weekly sessions of mindfulness-centred group therapy (e.g., awareness of emotions and their influence on the body or keeping a mindful mind-set in difficult situations, 100 min) and two weekly sessions of interactional group therapy (e.g., biographical experiences and personal belief system, or conflict management, 100 min). The interactional group therapy included cognitive behavioural therapy elements (e.g., identifying stress-intensifying thoughts) similar to those promoted in MBCT (Segal et al. 2013). These core elements were complemented by depression-related and work-related psychoeducation (50 min, twice a week) and physical activity (e.g., Nordic Walking, 50 min, twice a week), as well as four individual psychotherapy sessions over the course of the treatment (each 50 min). Each treatment day consisted of four or five treatment modules that were carried out as a group-based intervention: the morning meditation for 25 min, one module of 100 min and two or three of 50 min, amounting to a minimum of 225 min per day (see Online Resource 2 for a depiction of the weekly schedule). Over the course of 8 weeks, patients received 150 h of treatment in total.

The treatment concept and the respective modules were based on three defined pillars (with each treatment module adding new ways of relating to automatic work-related behaviour and thoughts, promoting disengagement, letting go (e.g., of perfectionism), acceptance and present-moment awareness). The first pillar of the treatment concept aimed at instructing practice in formal (i.e., meditation) and informal mindfulness exercises (e.g., being mindful while preparing and eating meals). The body and activation-based treatment modules (i.e., Yoga, Qigong, Nordic Walking), for example, were conceptualised to promote awareness for bodily states and needs. Patients were instructed to develop an awareness of their physiological stress limit and to recognise the early onset of stress and exhaustion. Other practical treatment modules, such as plasticising or cooking, were conceptualised to promote a mindful mind-set in everyday actions, i.e. while doing manual work or domestic chores. The patients were instructed to execute daily routines like cooking, Nordic walking or working with their hands with a mindful awareness and to savour the difference in the sensual input. The second pillar of the treatment concept aimed to help patients become experts of their own psyche by imparting knowledge on, e.g., the onset of specific symptoms, research findings on stress and depression and meditation outcomes, or reflection and understanding of biographical experiences and the resulting mind-

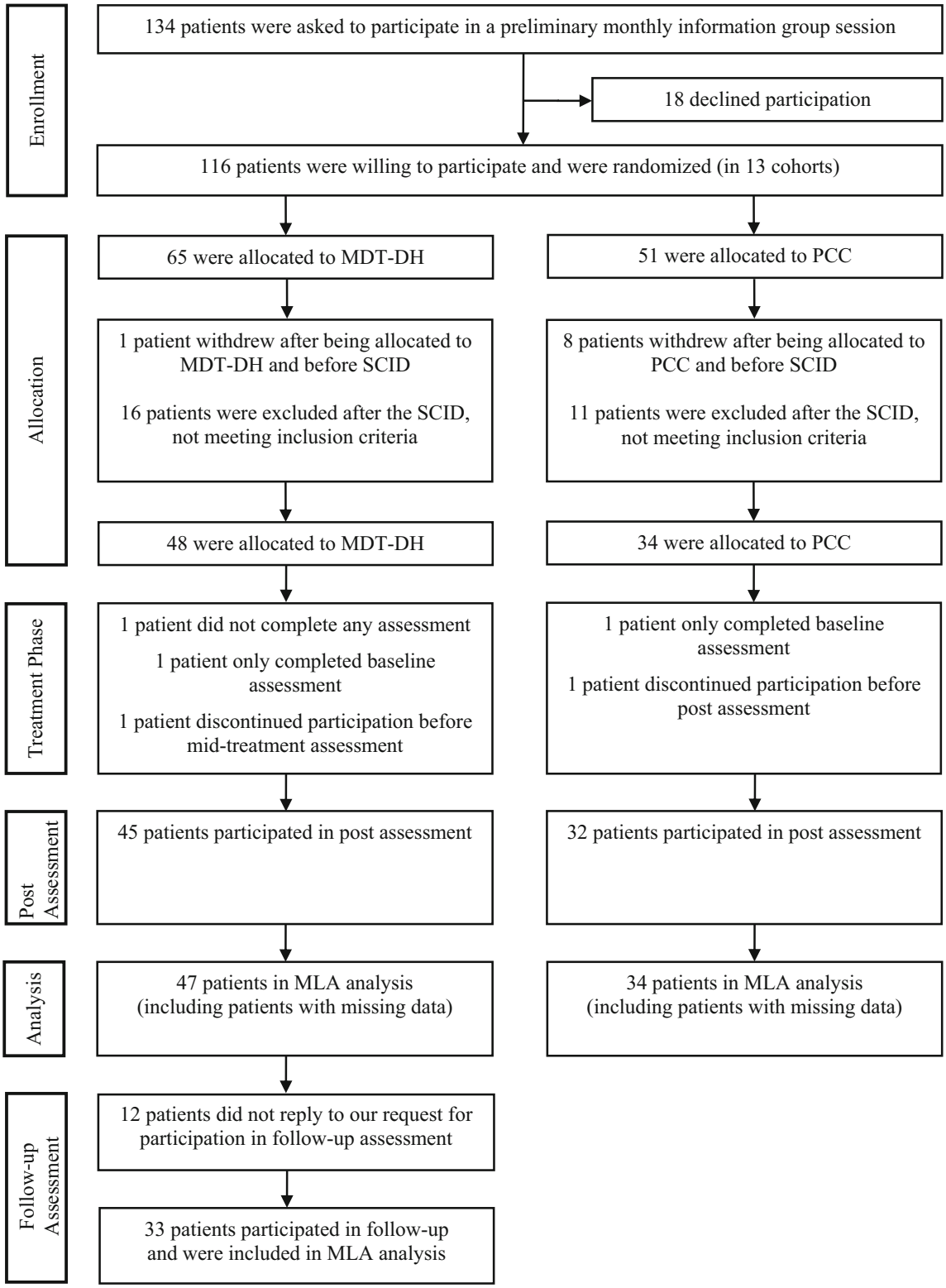

Fig. 1 CONSORT flow diagram. MDT-DH, Mindful Depression Treatment in a Day Hospital; PCC, Psychopharmacological Consultation Control group

set. It was essential to the treatment concept to identify automatic emotional or cognitive reactions to stressors ('autopilots') (Hülsheger et al. 2013; Siegel 2009) and to develop an understanding of how they shape (re)actions. While some psychoeducation modules focused on topics relevant to understanding stress, others focused on work-related aspects such as

communication skills and conflict de-escalation (e.g., learning to accept criticism, setting boundaries in a calm and determined manner and giving constructive feedback). The third pillar aimed at further promoting the patients' progress from theoretical reflection on mindfulness to practical application of a mindful mind-set in their everyday life by asking patients to perform specific homework, e.g. daily meditation, or by planning a detailed return to work strategy. Please see Online Resource 3 for a brief overview of the treatment concept and contents over the course of the 8 weeks.

The intervention providers consisted of two trained clinicians (clinical psychologist and psychiatrist) with extensive mindfulness experience (e.g., daily mindfulness practice, participation in retreats), and two certified MBSR/MBCT-teachers. The occupational therapists and nursing staff all attended an MBSR course in preparation of their work. All day hospital employees regularly practiced mindfulness, frequently participated in the morning meditation practice at the day hospital, and were willing and able to embody a mindful mind-set as patient role models. In addition, all day hospital patients were offered medication based on the German guidelines for the treatment of depression (National Guideline for Depression DGPPN 2015). Patients took part in weekly medical rounds with the senior physician, in which psychopharmacological treatment was prescribed if necessary.

Psychopharmacological Consultation Condition The effects of the MDT-DH were compared with a control condition in which participants waited to receive the treatment in the day hospital. We wanted to ensure that the two groups did not show systematic differences in medication use. For this reason, participants in the PCC group received a psychopharmacological consultation with the same day hospital physician who consulted patients in the MDT-DH group and were given an individualised written medical recommendation for their general practitioner or psychiatrist. This consultation took place at the start of their participation in the study to equate any medical treatment during the waiting time with the usual psychopharmacological treatment in the day hospital. All participants in the PCC group received the MDT-DH treatment after the waiting period.

Measures

Work-Related Stressors As the day hospital has a clear focus on work-related stressors, a history of stressors leading to the current crisis was determined in a short telephone interview before inviting patients to attend the information session (see Recruitment). After being included in the study, work-related stressors were assessed in the demographic questionnaire in the baseline assessment ("In your opinion, which of the following occupational stress factors contributed to your current crisis and exhaustion? Please select none, one or more of the options listed, or add another option: e.g., conflicts with superiors, conflicts with colleagues, high workload and overtime, increased performance expectations, fear of job loss").

Primary Outcome We used the Beck Depression Inventory (BDI-II; Beck et al. 1996; German version; Hautzinger et al. 2006) to assess depression severity as primary outcome. The BDI-II is a well-known 21-item self-assessment questionnaire that covers cognitive, affective, motivational and somatic symptoms of depression. The test-retest reliability of the BDI-II is adequate (ranging from 0.73 to 0.96), as is its internal consistency (0.9) and validity in clinical samples (Wang and Gorenstein 2013). The internal consistency (Cronbach's alpha) over the course of this study was between 0.83 and 0.95.

Secondary Outcomes To assess mindfulness, we used the Kentucky Inventory of Mindfulness Skills (KIMS-D; Baer et al. 2004; German version: Ströhle et al. 2010), a 39-item self-report inventory covering four behaviourally oriented facets of mindfulness: observing or attending to internal and external stimuli (e.g., 'I notice when my moods begin to change'), describing and labelling phenomena non-judgmentally (e.g., 'I'm good at finding words to describe my feelings'), acting with awareness in which undivided attention is focused on one thing at a time (e.g., 'When I do things, I get totally wrapped up in them and don't think about anything else'), and accepting or allowing present moments or events to occur without judging them (e.g., 'I tell myself that I shouldn't be feeling the way I'm feeling'). The German KIMS scales show adequate to good internal consistency ($\alpha > 0.76$). The test-retest reliabilities of the four scales were between 0.65 and 0.86 (Baer et al. 2004; Baum et al. 2010). Internal consistencies (Cronbach's alpha) among each of the KIMS subscales over the course of this study were as follows: observe = 0.92–0.95, describe = 0.89–0.95, act with awareness = 0.78–0.89, act without judgement = 0.90–0.95.

To assess work ability we used the Work Ability Index (WAI; Tuomi et al. 1994). The WAI is a self-administered questionnaire with seven items (e.g., "How do you rate your current work ability with respect to the physical/mental demands of your work?"; "Do you believe, according to your present state of health, that you will be able to do your current job two years from now?"). It assesses a worker's ability to perform his or her job, taking into account specific psychosocial and physical work-related factors, mental and physical abilities, and health (van den Berg et al. 2008), and comprises the following aspects: (i) subjective estimation of present work ability compared with the lifetime best, (ii) subjective work ability in relation both to physical and to mental demands of the work, (iii) number of diagnosed diseases, (iv) subjective estimation of work impairment due to disease, (v) number of days away from the job due to sickness during the past year, (vi) one's own prognosis of work ability in 2 years, and (vii) mental resources (to enjoy

daily activities, etc.). Based on the WAI score, an individual's work ability can be classified into four categories: poor (7–27), moderate (28–36), good (37–43) and excellent (44–49). In an extensive international survey of 38,000 nurses from ten European countries, the internal reliability (Cronbach's alpha) for the total sample was found to be satisfactory at 0.72 (Radkiewicz et al. 2005). A factor analysis did not support the implicit assumption of the homogeneity of the WAI, but rather showed that the seven items group into two factors: (1) subjective assessment of ability to work and one's own mental resources and (2) objective information concerning one's own health and absenteeism due to illness. However, for the German sample a single-factorial solution was determined (Radkiewicz et al. 2005). Analyses of correlations showed the predictive power of WAI to be strong and consistent, and in the expected direction. The higher the WAI score, the higher an individual's General Health Index ($r = 0.67$) (Radkiewicz et al. 2005). The WAI and all its items reliably predicted work disability, retirement and mortality (Ilmarinen 2007). The internal consistency (Cronbach's alpha) over the course of this study was between 0.54 and 0.77.

Data Analyses

Prior to our main analyses, we conducted independent *t* tests (continuous variables) and χ^2 tests (categorical variables) on all available baseline information to rule out systematic differences between treatment and control conditions (MDT-DH vs. PCC). Furthermore, we explored potential differences in baseline characteristics between dropouts and completers using χ^2 test or *t* test.

For our main analyses, we used linear mixed-effects models to examine effects of group assignment (treatment or control group) and treatment duration on outcome. A linear effect of time was included as well as the treatment condition and an interaction term of time and treatment condition. The individuals nested in cohorts represent a grouping factor and were introduced as a random effect in the model. In order to control for medication effects (psychopharmacological medication vs. no medication) and number of depressive episodes (first episode vs. recurrent), we included these variables as factors in the model. Due to a lack of support for an overarching mindfulness factor (Baum et al. 2010), we used the sum of each KIMS subscale in a second analysis to explore whether facets of mindfulness were differentially affected. We included the four mindfulness subscales as additional variables in the mixed model. As this exceeded the possible number of estimated parameters, we excluded the medication effects and number of depressive episodes as factors for this analysis and only modelled for the correlation of repeated measurements per participant. Significance of fixed effects was determined by Satterthwaite's method for approximating the degrees of freedom (Satterthwaite 1946). All analyses were performed using *R* (Team 2018) and the package lme4 (Bates et al. 2015) and lmerTest (Kuznetsova et al. 2017).

In order to estimate the pre-post effect sizes for patients within MDT-DH on outcome variables without consideration of model parameters, we calculated Cohen's *d* (Cohen 1988) based on observed values as $d_{\text{Repeated Measures}}$ (d_{RM}). This was done by correcting the standard deviation based on the correlation between baseline and post-assessment (Morris and DeShon 2002) and using the standard deviation of the baseline (Morris 2008): $\sigma_D = \sigma \times \sqrt{2 \times (1-\rho)}$. Furthermore, to estimate the effect sizes for the difference between MDT-DH ($n = 45$) and PCC ($n = 32$) at post-assessment, we calculated Hedges' *g* (Hedges and Olkin 1985) on the basis of Cohen's *d* (Cohen 1988) by adjusting the calculation of the pooled standard deviation with weights for the reduced sample size in PCC. All calculations were computed with tools offered by Psychometrica (Lenhard and Lenhard 2016).

Especially in a clinical context, it is important to not only determine the statistical significance of self-reported changes in depression severity but also the clinical relevance of the results. Thus, we used the Jacobson and Truax (1991) formula for 'reliable change' (RC) in depression severity based on the reliability of the BDI-II ($r_{tt} = .78$) (Kühner et al. 2007) to allocate patients to one of four clinical change categories. A BDI-II score difference was considered 'improved' if the RC was less than or equal to − 1.96 (95% confidence interval). A BDI-II score difference was considered clinically meaningful and 'reliably improved' if, in addition to being improved, the BDI-II value passed the cut-off score of 14 (minimal depression) in a non-clinical population. A BDI-II score difference was considered 'unchanged' if the RC was between − 1.96 and 1.96 and 'deteriorated' if the RC was more than 1.96. We calculated a χ^2 test to test for difference in the clinical change category between participants in MDT-DH and PCC.

With respect to the participants work ability, we were interested to determine the changes in the respective Work Ability Index (WAI) categories. We therefore additionally computed mean scores in work ability at baseline and post-assessment, as well as at follow-up 8 months after post-assessment for participants with complete data ($n = 81$). A chi-square test was calculated comparing the distribution of index categories in the WAI in both group conditions at baseline and post assessment.

Results

Descriptive Statistics and Baseline Characteristics

All included study participants ($N = 81$) reported one or more work-related stressors (see Table 2). We found no significant

Table 2 Self-reported work-related stressors (sorted by percentage)

	$N = 81$		PCC ($n = 34$)		MDT-DH ($n = 47$)		p value
	n	%	n	%	n	%	
High workload and overtime	58	71.6	25	73.5	33	70.2	0.74
Increased expectations of performance	49	60.5	23	67.6	26	55.3	0.26
Conflicts with superiors	35	43.2	13	38.2	22	46.8	0.44
High amount of work-specific conflicts	34	42.0	15	44.1	19	40.4	0.74
No or too few breaks	32	39.5	17	50.0	15	31.9	0.10
Overtime without compensation	31	38.5	13	38.2	18	38.3	0.99
Conflicts with colleagues	28	34.6	8	23.5	20	42.6	0.08
Lack of flexibility in work processes	21	25.9	9	26.5	12	25.5	0.92
Increased responsibility	19	23.5	10	29.4	9	19.1	0.28
New job/responsibilities due to restructuring	19	23.5	8	23.5	11	23.4	0.99
Fear of job loss	17	21.0	8	23.5	9	19.1	0.63
Boring and uninteresting work	10	12.3	4	11.8	6	12.8	0.89
Shift work	9	11.1	3	8.8	6	12.8	0.58
Too few demands and underload	5	6.2	1	2.9	4	8.5	0.30
High amount of travel	3	3.7	1	2.9	2	4.3	0.76
Constant availability	3	3.7	1	2.9	2	4.3	0.76
Other/additional work-related stressors	21	25.9	10	29.4	11	23.4	0.54

Work-related stressors were assessed by questionnaire at the baseline assessment. Patients could choose none, one or more stressors from a predefined list and state additional stressors. Additional stressors (e.g., sales force activities, 24-h duty, work life crisis, conflict with a customer) were only listed above if more than one patient stated them. The p value was calculated by χ^2 test

group differences in any of the sociodemographic or clinical variables (all p values > 0.05) (see Table 1 for sample characteristics at baseline assessment and Table 3 for outcome measures). Furthermore, the percentage of participants using psychopharmacological medication in PCC and MDT-DH did not differ significantly at the baseline assessment (PCC $n = 15$, 44.1%; MDT-DH $n = 15$, 31.9%; $p = 0.26$) nor at post-assessment (PCC $n = 14$, 43.8%; MDT-DH $n = 17$, 37.8%; $p = 0.60$). In addition, we found no significant differences in the types of pharmacological treatment received by participants in PCC and MDT-DH over the course of the study (see Online Resource 4).

Dropout and Non-participation

Even though a few participants (6.2%) discontinued participation in the study (MDT-DH $n = 3$; PCC $n = 2$), no participant dropped out of the actual treatment. Thus, non-participation in MDT-DH did not lead to discontinuation of the treatment, nor did it change the desire to be admitted to treatment in former PCC participants. Nevertheless, we checked for a possible systematic bias in participants who discontinued study participation and found a significant difference in baseline depression severity, $t(45) = -3.13$, $p = 0.003$, between MDT-DH patients who completed post-assessment ($n = 45$, $M = 24.62$, SD = 7.23) and those who no longer participated ($n = 2$, $M = 41.00$, SD = 7.07). In the PCC, we found no difference in baseline depression severity between participants who completed post-assessment ($n = 32$, $M = 26.78$, SD = 7.82) and those who no longer participated ($n = 2$, $M = 24.5$, SD = 9.19), $t(32) = 0.40$, $p = 0.693$. With regard to the patients who no longer participated in MDT-DH after post-assessment ($n = 12$) and patients with complete data ($n = 33$) who took part in the follow-up assessment 8 months later, we found no differences in sample characteristics (all p values > 0.05, see Table 2) and outcomes (see Table 3). These results suggest that non-participation did not occur due to systematic differences in depression severity, work ability or mindfulness levels, but resulted from other reasons unknown to the authors.

Effectiveness of MDT-DH vs. PCC

The mixed effects models showed a non-significant effect of time and treatment condition ($p > .05$), but a significant time by group interaction for all outcome measures (BDI-II, KIMS, WAI). Furthermore, the results show that the outcome measures remained relatively stable in PCC during the waitlist period, but changed favourably in MDT-DH. All estimated parameters are summarised in Table 4. The change patterns are visualised in Fig. 2. The improvements observed in the MDT-DH condition remained stable over the follow-up

Table 3 Observed means and standard deviations (in parentheses) in outcome measures in PCC, MDT-DH and patients who did not complete follow-up (non-completer) over the course of the study

	PCC *M* (SD)	MDT-DH *M* (SD)	*t* (79)[c]	*p* value[c]	MDT-DH[b] (*n* = 33) *M* (SD)	Non-completer[d] (*n* = 12) *M* (SD)	*t* (43) [e]	*p* value[e]
BDI-II								
Baseline[a]	26.65 (7.77)	25.32 (7.91)	0.75	0.455				
Post	26.19 (8.40)	10.04 (9.30)			10.18 (8.29)	9.67 (12.09)	− 0.16	0.872
Follow-up[b]	–	11.39 (10.47)						
WAI								
Baseline[a]	20.32 (4.74)	20.73 (6.04)	0.33	0.743				
Post	19.81 (4.82)	29.00 (7.53)			29.50 (7.34)	27.63 (8.21)	− 0.74	0.467
Follow-up [b]	–	31.45 (8.38)						
KIMS (total)								
Baseline[a]	2.78 (0.38)	2.88 (0.42)	− 1.10	0.276				
Post	2.76 (0.38)	3.53 (0.53)			3.51 (0.44)	3.54 (0.57)	− 0.16	0.877
Follow-up[b]	–	3.40 (0.56)						
KIMS-O								
Baseline[a]	32.85 (8.01)	34.51 (8.14)	− 0.911	0.365				
Post	33.94 (7.58)	42.56 (7.43)			43.24 (7.91)	40.67 (5.80)	− 1.03	0.309
Follow-up[b]	–	39.49 (8.65)						
KIMS-D								
Baseline[a]	21.77 (6.42)	22.17 (6.79)	− 0.271	0.787				
Post	22.22 (6.20)	28.49 (5.72)			28.79 (6.14)	27.67 (4.49)	− 0.58	0.567
Follow-up[b]	–	26.21 (7.49)						
KIMS-A								
Baseline[a]	26.48 (5.54)	26.77 (6.37)	− 0.217	0.829				
Post	25.72 (5.23)	32.82 (7.28)			32.88 (7.17)	32.67 (7.89)	−.09	.932
Follow-up[b]	–	31.82 (5.59)						
KIMS-J								
Baseline [a]	27.38 (7.95)	28.89 (8.01)	−8.41	0.403				
Post	25.75 (5.83)	33.78 (7.17)			33.03 (7.12)	35.83 (7.21)	1.16	0.251
Follow-up [b]	–	34.97 (8.63)						

PCC, Psychopharmacological Consultation Control group; *MDT-DH,* Mindful Depression Treatment in a Day Hospital. *BDI-II,* Beck Depression Inventory-II; *WAI,* Work Ability Index; *KIMS (total),* Kentucky Inventory of Mindfulness Skills; *KIMS-O,* subscale observe; *KIMS-D,* subscale describe; *KIMS-A,* subscale act with awareness; *KIMS-J*, subscale act without judgement. The baseline assessment took place at the start of the study and post-assessment was 8 weeks after baseline. The follow-up assessment was conducted 8 months after post assessment. There was no follow-up in PCC

[a] Please note that at baseline we analysed all patients with available data ($N = 81$), yet at post-assessment there where 2 patients per treatment condition who discontinued the study

[b] Only 33 patients in the MDT-DH participated in the follow-up

[c] All *t* and *p* values stated refer to a comparison of outcomes between PCC and MDT-DH at baseline

[d] MDT-DH patients with post-assessment data, but without follow-up data ($n = 12$)

[e] All *t* and *p* values stated refer to a comparison in post-assessment outcomes between patients who completed follow-up in MDT-DH and those, who no longer participated after post-assessment

period. Inclusion of the use of psychopharmacological medication in the model, to preclude the influence of medication use on the treatment effect, found no evidence for an effect of psychopharmacological medication between the treatment conditions. In a further exploratory analysis, we included the number of depressive episodes (first vs. two or more episodes) as a factor and found a non-significant effect of the number of episodes on depression severity ($p = 0.063$) and a significant effect on mindfulness ($p = 0.006$). This indicates that participants with a recurrent depression are on average more depressed and significantly less mindful than participants with a first episode. Furthermore, we found that all four subscales changed over the course of the study in MDT-DH but remained stable in PCC. This indicates that the MDT-DH treatment leads to significant and stable changes in different facets of mindfulness.

Table 4 Parameter estimates and standard errors of the linear mixed models

Outcome		*b*	SE	df	*t*	*p*
BDI-II	Intercept	24.94	1.82	38.55	13.720	< 0.001
	Medication	0.68	1.49	132.75	0.452	0.652
	Recurrent episodes	3.11	1.65	74.33	1.884	0.063
	Time	− 0.09	0.18	32.49	− 0.486	0.630
	MDT-DH	− 1.45	1.67	71.36	− 0.868	0.388
	MDT-DH × time	− 1.78	0.22	72.83	− 8.044	< 0.001
WAI	Intercept	20.93	1.16	135.77	18.004	< .001
	Medication	− 0.10	1.02	131.14	− 0.981	0.328
	Recurrent episodes	− 0.37	0.10	144.94	− 0.369	0.712
	Time	− 0.05	0.19	46.09	− 0.250	0.803
	MDT-DH	0.37	1.35	117.33	0.276	0.783
	MDT-DH × time	1.11	0.24	105.84	4.542	< 0.001
KIMS	Intercept	2.84	0.08	142.50	34.735	< 0.001
	Medication	0.07	0.07	151.88	0.930	0.354
	Recurrent episodes	− 0.20	0.07	150.74	− 2.764	0.006
	Time	− 0.00	0.01	67.34	− 0.246	0.806
	MDT-DH	0.11	0.10	139.49	1.173	0.243
	MDT-DH × time	0.09	0.02	147.13	5.077	< 0.001
KIMS-O	Intercept	32.85	1.34	124.99	24.497	< 0.001
	Time	0.10	0.80	75.78	0.596	0.553
	MDT-DH	1.66	1.76	124.99	0.942	0.348
	MDT-DH × time	0.90	0.23	75.57	3.926	< 0.001
KIMS-D	Intercept	21.77	1.08	110.02	20.214	< 0.001
	Time	0.04	0.12	77.18	0.326	0.745
	MDT-DH	0.41	1.41	110.02	0.287	0.775
	MDT-DH × time	0.76	0.15	77.03	5.049	< 0.001
KIMS-A	Intercept	26.47	1.08	139.80	24.633	< 0.001
	Time	− 0.09	0.16	78.72	− 0.599	0.551
	MDT-DH	0.29	1.41	139.80	0.209	0.834
	MDT-DH × time	0.85	0.21	78.47	4.089	< 0.001
KIMS-J	Intercept	27.38	1.27	115.98	21.630	< 0.001
	Time	− 0.17	0.15	75.92	− 1.138	0.259
	MDT-DH	1.51	1.66	115.98	0.909	0.365
	MDT-DH × time	0.78	0.19	75.74	3.999	< 0.001

Mean scores at baseline for the reference group, medication effect, number of depressive episodes effect, time effect, group effect and interaction effect between time and group. *MDT-DH*, Mindful Depression Treatment in a Day Hospital ($n = 47$). *BDI-II*, Beck Depression Inventory-II; *WAI,* Work Ability Index; *KIMS,* Kentucky Inventory of Mindfulness Skills; *KIMS-O*, subscale observe; *KIMS-D*, subscale describe; *KIMS-A*, subscale act with awareness; *KIMS-J*, subscale act without judgement. The baseline assessment took place at the start of the study; post-assessment was 8 weeks after baseline. The follow-up assessment was conducted 8 months after post-assessment

Based on observed means within the MDT-DH condition, we found large effect sizes for the reduction in depression severity, $d_{RM} = 1.93$, 95% CI [1.44, 2.42], and the increases in work ability, $d_{RM} = 1.19$, 95% CI [0.75, 1.63], and mindfulness, $d_{RM} = 1.22$, 95% CI [0.78, 1.67], at post-assessment. Effect sizes for the increases in the four subscales at post-assessment were as follows: observe, $d_{RM} = .83$, 95% CI [0.41, 1.25], describe, $d_{RM} = 1.02$, 95% CI [0.59, 1.45], act with awareness, $d_{RM} = 0.79$, 95% CI [0.37, 1.20] and act without judgement, $d_{RM} = 0.67$, 95% CI [0.25, 1.08]. Furthermore, comparing MDT-DH with PCC at post-assessment, we found large effect sizes for depression severity, $g_{Hedges} = 1.80$, 95% CI [1.27, 2.34], work ability, $g_{Hedges} = 1.40$, 95% CI [0.89, 1.91] and mindfulness, $g_{Hedges} = 1.62$, 95% CI [1.10, 2.14]. Effect sizes for the increases in the four subscales were as follows: observe, $d_{RM} = 1.15$, 95% CI [0.66, 1.64], describe, $d_{RM} = 1.06$, 95% CI [0.58, 1.54], act with awareness, $d_{RM} = 1.09$, 95% CI [0.61, 1.58] and act without judgement, $d_{RM} = 1.21$, 95% CI [0.72, 1.70].

Clinical Change and Work Ability Categories

The distribution of clinical change categories, WAI scores and categories is presented in Table 5. At post-assessment, 33 (73.3%) MDT-DH patients with complete data ($n = 45$) showed an improvement in depression severity, of which 29 (64.4%) were reliably improved. In the PCC ($n = 32$), four patients showed an improvement, of which two could be labelled reliably improved (6.3%). There was a highly significant difference in the distribution of clinical change categories between PCC and MDT-DH at post-assessment, χ^2 (2) = 28.11, $p < 0.001$. Furthermore, results did not reveal a significant association between the distribution of WAI categories and the treatment condition at baseline assessment, χ^2 (1) = 0.79, $p = 0.372$, yet a highly significant association at post-assessment, χ^2 (2) = 20.42, $p < 0.001$.

Discussion

The current randomised controlled pilot study investigated the effectiveness of a mindfulness-based treatment for depression and work-related conflicts under the naturalistic conditions of a day hospital setting integrated in the regular health care system. The preliminary findings support our hypothesis that MDT-DH outperforms the PCC on self-report measures of depressive symptoms, work ability and mindfulness and support the effectiveness of MDT-DH on depression severity, mindfulness and work ability. Effects were assessed at the end of treatment and appeared to remain stable over an 8-month follow-up period. Additional analyses of the differential effects of the four mindfulness subscales showed that changes were observable in each mindfulness facet. Altogether, the current results indicate that a mindfulness-based approach can be successfully established in a day hospital setting. This might offer more seriously depressed patients, who are in need of more intensive treatment than the

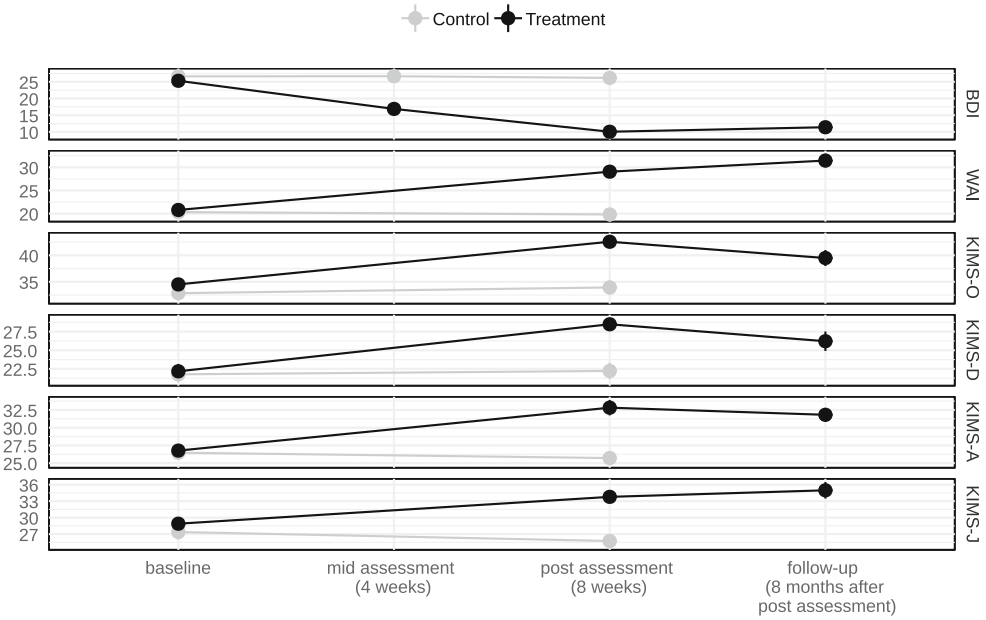

Fig. 2 Observed mean (± standard error) of depression (BDI-II), work ability (WAI) and mindfulness (KIMS) subscales and score values over time for control (PCC, Psychopharmacological Consultation Control) and treatment group (MDT-DH, Mindful Depression Treatment in a Day Hospital). KIMS-O, subscale observe; KIMS-D, subscale describe; KIMS-A, subscale act with awareness; KIMS-J, subscale act without judgement

classical 8-week MBSR or MBCT intervention, a higher dosed mindfulness-based treatment. In contrast to inpatient settings, the MDT-DH provides patients with more opportunities to transfer mindfulness and other skills into their daily lives.

Strengths of this study include the use of a randomised controlled trial design under naturalistic treatment conditions in a day hospital. The study design, however, did not include an active treatment in comparison with control for non-mindfulness-specific treatment factors (e.g., home practice exercises, relaxation and placebo expectancies). It is therefore not possible to evaluate whether MDT-DH has a unique treatment effect above and beyond common therapeutic factors (e.g., group support, more extended attention from therapists)

Table 5 Clinical change categories (CCC) and Work Ability Index (WAI) scores and diagnostic categories in PCC and MDT-DH over the course of the study

	PCC		MDT-DH		
Time of assessment	Baseline assessment	Post-assessment	Baseline assessment	Post-assessment	Follow-up assessment
n	34	32	47	45	33
CCC categories[a]					
Reliably improved	–	0	–	29	–
Improved	–	4	–	4	–
Unchanged	–	27	–	12	–
Deteriorated	–	1	–	0	–
WAI *M* (SD)	20.32 (4.74)	19.91 (5.24)	20.73 (6.04)	28.45 (7.84)	31.45 (8.38)
WAI range	10–31	11–31	11–32	11–42	9–46
WAI categories[b]					
Very good	0	0	0	0	2
Good	0	0	0	9	7
Moderate	4	5	9	21	15
Critical	30	29	38	17	9

PCC, Psychopharmacological Consultation Control group; *MDT-DH*, Mindful Depression Treatment in a Day Hospital; *CCC*, clinical change categories based on reliable change (RC); *WAI*, Work Ability Index. Please note that only 33 patients in the MDT-DH participated in the follow-up. Means and standard deviations at the baseline assessment were calculated with all available data ($N = 81$)

[a] Clinical change was only assessed at post-assessment ($n = 77$)

[b] An individual's work ability (WAI) can be classified into four categories (by mean score): critical (7–27), moderate (28–36), good (37–43) and very good (44–49)

or non-mindfulness-specific factors (e.g., psychoeducation, cognitive restructuring).

We optimised the waitlist condition by integrating a consultation with our day hospital physician at the start of PCC to equate the medical treatment during the waiting time with the usual psychopharmacological medication in the day hospital. By doing this, we aimed to eliminate the influence of the patients' psychopharmacological treatment in the analyses of the effectiveness of MDT-DH. These findings therefore provide a valuable initial evaluation of whether MDT-DH has an impact on outcomes above and beyond standard care or no treatment. However, we must point out that while the majority of participants in the waitlist condition were on sick leave during this time, some may have continued to work. The continuing stress of work may have had an influence on symptom severity and motivation to participate in the study. Future studies should compare MDT-DH with active control conditions to determine the role of mindfulness and the comparative effectiveness of mindfulness-based programmes in general (see MacKenzie et al. 2018) and the current MDT-DH approach in specific. Designs using a waitlist condition should make sure that all participants have a comparable stress level and should control for sick leave during participation.

Limitations and Future Research

The Cohen's *d* effect sizes we found are large in magnitude and higher than those observed in meta-analyses on MBPs (Hofmann et al. 2010; Khoury et al. 2013). However, these comparisons should be drawn tentatively because of difference in study samples, designs and analytic strategies between the studies included in these meta-analyses and our present study (Goldberg et al. 2018). Furthermore, the large effects we observed for the MDT-DH may simply be due to the high dose of treatment. Compared with MBCT, which consists of one pre-class interview and eight group sessions of 2.5 h, the treatment dose of 150 h in the current study was much higher. In addition to dose effects, the high and stable treatment gains observed may also be attributable to the specific interplay between intensive daily formal mindfulness training and the transfer to informal mindfulness practice and work-related problems. Future studies should explore these open questions. We would also like to point out that findings on the work ability of patients should be interpreted with caution, as the internal consistency (Cronbach's alpha) over the course of this study was relatively low. Future studies should use structurally matched conditions or a dismantling design to compare different treatment doses. By this means, factors explaining differential treatment effects may be elucidated in a methodologically more rigorous manner. Further research should also include data on the cost effectiveness of different settings, i.e., outpatient, inpatient and day hospital.

A further weakness of the study design is the process of participant inclusion and randomisation to study condition. Due to procedural aspects of the day hospital admission, we did not ascertain inclusion criteria before allocation to condition. This led to an uneven distribution of participants to the study conditions, which we tried to compensate for by adjusting the allocation ratio throughout the study. Having to allocate participants to study condition before the preliminary diagnostic interview took place resulted in 24.6% of the MDT-DH and 20% of the PCC participants not fulfilling the study inclusion criteria. The resultant uneven distribution was exacerbated by the fact that more participants declined participation (18%) after learning that they had been allocated to the PCC group and not the MDT-DH. The main reason stated for post-randomisation dropout was the time and effort participation in the PCC condition posed. The highest no-show rate was during summer school holidays (during which the PCC treatment would have taken place) because of a lack of childcare options. We would also like to point out that participants in PCC may have been disappointed to have been randomised to the control condition instead of MDT-DH, which could have led to demoralisation and subsequent increase in depression scores. Participants in MDT-DH, on the other hand, may have felt motivated and therefore less depressed. However, there were no significant baseline differences in depression scores between conditions and only a minimal descriptive difference. Therefore, we do not see grounds for a substantial bias. If the above-mentioned effect on depression severity within the MDT-DH group occurred, with subsequent minimally decreased depression scores, it likely would have led to a statistically even more conservative estimate of the effectiveness of the MDT-DH. It is also important to point out that there was no procedure to monitor reliability of SCID ratings among raters and no procedure for establishing treatment fidelity. Future research should ideally use clinically experienced raters for the SCID interviews and monitor for reliability as well as for treatment fidelity.

The MDT-DH treatment concept is highly tailored to depressed patients with work-related conflicts. This might be a beneficial feature of the programme because the maintaining factors of depression can be specifically addressed. However, this might also limit the generalisability of the results of our trial. The pre-selection of patients by the treatment focus on work-related conflicts could have led to a specific and high-performance subgroup of depressive patients. Because of their motivation to return to their workplace and their former performance or functioning, patients in our study might have been more willing to engage in treatment and to participate in the treatment

components that were offered in MDT-DH. Furthermore, the sample was well educated and might have been able to reflect on the inner conflict more intensely, which could have further facilitated their improvement within treatment. Finally, a majority of patients were partnered and had good social support, which may have promoted a stronger exchange of ideas and provided more feedback in comparison with patients who were single or had few friends. Correspondingly, the specific subgroup of depressive patients included in our study may thus show sample characteristics different to samples in other studies of depression treatments.

With regard to long-term effectiveness, we must point out that our results should be interpreted with caution due to the number of patients in the MDT-DH group who completed post-assessment, yet did not complete follow-up 8 months later. It should be noted that MDT-DH patients who stopped participation during the study tended to have higher BDI-II baseline scores. Therefore, it cannot be ruled out that selective responding had some influence on our results. Even though we conducted statistical analyses to check for systematic differences between patients with complete data sets and those who did not complete post assessment, it is still possible that between end-of-treatment and the final follow-up, the more stressed or less improved patients stopped participating, while the more motivated and highly improved patients completed the study. This could have led to more positive and sustained results at follow-up. It may be, therefore, that the treatment concept was more successful in this study than it would have been had the more depressed patients been included. Further studies are necessary to determine the effectiveness of MDT-DH in other patient groups and to more rigorously test the long-term effectiveness of the programme. Furthermore, even though the diagnostic eligibility was verified by a structured interview, the effectiveness of MDT-DH was only assessed with self-report measures of depression, mindfulness and work ability. In future studies, we recommend to include rater-based assessments of depressive symptoms.

Despite the foregoing, it should be noted that the naturalistic setting yields findings with high external validity. The realisation of MDT-DH within the psychiatric clinic was, however, facilitated by a number of factors, e.g., the use of trained clinicians with personal mindfulness experience who developed and upheld the pillars of the treatment concept, which might not be easy to realise in other day hospitals. Future research should include checks for adherence and competency to investigate the impact of therapist variables. Moreover, if the treatment were to be implemented in other day hospitals, it could be useful to investigate facilitating and hindering implementation factors. In addition, patients were encouraged to engage in mindfulness practice by giving them homework (e.g., several minutes of meditation per day slowly increasing over time), but were not monitored for compliance. Future research should monitor for patients adherence to homework assignments.

In summary, this randomised controlled pilot study showed that an intensive eight-week mindfulness-based treatment concept can be effectively established in a day hospital setting and is efficacious in reducing depression severity under routine clinical conditions. We propose that a day hospital treatment has several important advantages: the high treatment dose and the possibility to promote transfer from in-hospital experiences to daily life. Our findings provide preliminary evidence that MDT-DH can be a valuable treatment option for patients suffering from current depression, where this was developed or maintained in the context of work-related factors and who are in need of intensive treatment.

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Author Contributions AB: designed and executed the study, analysed the data, and wrote the paper. CR: collaborated with the design, execution and writing of the study. HU: collaborated with the design and writing of the study. NP: collaborated with the design and writing of the study. JM: collaborated with the design, writing and editing of the final manuscript. All authors approved the final version of the manuscript for submission.

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The funder of the study had no role in the study design, data collection, data analysis, interpretation of data, or writing of the paper. The corresponding author had full access to the data and had final responsibility for the decision to submit for publication.

Data Availability All data are available at the Open Science Framework (https://osf.io/gfqzy).

Compliance with Ethical Standards

Conflict of Interest AB, HU and NP declare a potential conflict of interest as employees of ASKLEPIOS Kliniken Hamburg GmbH of which the funding company, ASKLEPIOS proresearch, is a subsidiary company. HU is the Chief Medical Officer and Head of the Department of Psychiatry und Psychotherapy, ASKLEPIOS Klinikum Hamburg-Harburg. NP is the team leader in the day hospital. CR declares that she has no conflicts of interest. JM is the Director of the Achtsamkeitsinstitut Ruhr (an institute offering mindfulness training) and Principal Investigator on several DFG (German Science Foundation) research projects. He also receives royalties as the author of mindfulness books.

Ethical Approval The ethics committee of the University of Hildesheim approved the study and we obtained research governance approval from the local primary care health board, Ärztekammer Hamburg. All procedures were in accordance with the ethical standards of the institutional

research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed Consent All participants attended an information session and were given a written description of the procedure and content of the study as well as an estimation of time and effort required prior to participation. Informed consent was obtained from all individual participants included in the study.

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Publication of related reports

Please note that a sub-study investigating intuitive decision-making and mood regulation in depressive patients of a sub-set of patients was part of this trial. For a detailed description, please refer to Remmers et al. (2017) and Remmers et al. (2018).