# The Efficacy of Adapted MBCT on Core Symptoms and Executive Functioning in Adults With ADHD

Hepark, Sevket; Janssen, Lotte; de Vries, Alicia; Schoenberg, Poppy L. A.; Donders, Rogier; Kan, Cornelis C.; Speckens, Anne E. M.

*Published in:*
Journal of Attention Disorders

*DOI:*
10.1177/1087054715613587

*Article*

# The Efficacy of Adapted MBCT on Core Symptoms and Executive Functioning in Adults With ADHD: A Preliminary Randomized Controlled Trial

Journal of Attention Disorders
2019, Vol. 23(4) 351–362

DOI: 10.1177/1087054715613587
journals.sagepub.com/home/jad
SAGE

**Sevket Hepark[1], Lotte Janssen[1], Alicia de Vries[2], Poppy L. A. Schoenberg[1], Rogier Donders[1], Cornelis C. Kan[1], and Anne E. M. Speckens[1]**

**Abstract**

**Objective:** The aim of this study was to examine the effectiveness of mindfulness as a treatment for adults diagnosed with ADHD. A 12-week-adapted mindfulness-based cognitive therapy (MBCT) program is compared with a waiting list (WL) group. **Method:** Adults with ADHD were randomly allocated to MBCT ($n$ = 55) or waitlist ($n$ = 48). Outcome measures included investigator-rated ADHD symptoms (primary), self-reported ADHD symptoms, executive functioning, depressive and anxiety symptoms, patient functioning, and mindfulness skills. **Results:** MBCT resulted in a significant reduction of ADHD symptoms, both investigator-rated and self-reported, based on per-protocol and intention-to-treat analyses. Significant improvements in executive functioning and mindfulness skills were found. Additional analyses suggested that the efficacy of MBCT in reducing ADHD symptoms and improving executive functioning is partially mediated by an increase in the mindfulness skill "Act With Awareness." No improvements were observed for depressive and anxiety symptoms, and patient functioning. **Conclusion:** This study provides preliminary support for the effectiveness of MBCT for adults with ADHD. *(J. of Att. Dis. 2019; 23(4) 351-362)*

**Keywords**

ADHD, adults, mindfulness-based cognitive therapy, executive functioning, patient functioning

## Introduction

ADHD is a neurobiological developmental disorder with an age of onset before 7 years and a high persistence into adulthood (American Psychiatric Association [APA], 2000; Lara et al., 2009). It affects approximately 2.5% (95% confidence interval [CI] = [2.1, 3.1]) of the adult population worldwide (Simon, Czobor, Balint, Meszaros, & Bitter, 2009). In accordance with this figure, the prevalence of adult ADHD in the Netherlands was found to be 2.1% (95% CI = [1.4, 3.0]; Tuithof, Ten Have, van Dorsselaer, & de Graaf, 2014).

A growing body of evidence showed that ADHD is associated with impairments of executive functioning, which start to develop in early childhood. The term executive functioning refers to a set of inter-related higher-order abilities involved in self-regulatory functions that organize, direct, and manage cognitive activities, emotional responses, and overt behavior (Roth, Lance, Isquith, Fischer, & Giancola, 2013). A meta-analysis of 83 studies found associations between ADHD and impairments in executive functioning, particularly response inhibition, vigilance, working memory, and planning (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Deficits in executive functioning appeared to contribute significantly to occupational problems in adults with ADHD (Barkley & Murphy, 2010).

In addition, ADHD can be disruptive to various areas of personal functioning. For instance, ADHD is associated with poor work performance (de Graaf et al., 2008; Kessler et al., 2005), underattainment (Biederman et al., 2008), poor marital and family functioning (Eakin et al., 2004), driving impairment (Fischer, Barkley, Smallish, & Fletcher, 2007), and higher susceptibility to substance abuse (Lee, Humphreys, Flory, Liu, & Glass, 2011; Ohlmeier et al.,

[1]Radboud University Medical Center Nijmegen, The Netherlands
[2]University Medical Center Groningen, The Netherlands

**Corresponding Author:**
Lotte Janssen, Department of Psychiatry, Radboud University Medical Center Nijmegen, Reinier Postlaan 4, 6525 GC Nijmegen, The Netherlands.
Email: Lotte.Janssen@Radboudumc.nl

2007). Consequently, treatments for ADHD that may effectively alleviate symptoms and reduce functional impairment are highly relevant.

Pharmacotherapy with psycho-stimulants (methylphenidate and dexamphetamine) is the first-line treatment for adults with ADHD ("NICE guideline Attention Deficit Hyperactivity Disorder [ADHD]," 2013). Although there is evidence that stimulant medication has been effective in reducing ADHD symptoms (Faraone & Glatt, 2010; Meszaros et al., 2009; Wilens, Morrison, & Prince, 2011), improving work productivity, efficacy (Wigal et al., 2010), and improving driving performance (Verster et al., 2008), there is room for improvement. Approximately one third of the adults with ADHD are dissatisfied with the effect of their medication (Wilens et al., 2011). Second, some patients experience unwanted side effects, for example, diminished appetite, weight loss, and insomnia. Finally, some patients are not willing to take medications. Therefore, there is a need for effective psychosocial interventions for adults with ADHD that can be offered in addition to or instead of pharmacotherapy.

An innovative psychosocial intervention for adults with ADHD is mindfulness training. Mindfulness is defined as "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" (Kabat Zinn, 2003). It involves the self-regulation of attention so that it is maintained on immediate experience with an attitude of curiosity, openness, and acceptance (Bishop et al., 2004).

Some studies have shown evidence that mindfulness strengthens attention regulation in normal participants (Jha, Krompinger, & Baime, 2007; van den Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010). Moreover, in both healthy participants and patients with ADHD, there are indications that mindfulness training can improve other aspects of executive functioning, for instance, emotional regulation (Hill & Updegraff, 2012; Mitchell et al., 2017), working memory (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013), cognitive inhibition (Zylowska et al., 2008), and performance monitoring (Schoenberg et al., 2014).

Preliminary evidence has been found for the efficacy of mindfulness in adults with ADHD. Two pilot studies (Mitchell et al., 2017; Zylowska et al., 2008) used the 8-week mindful awareness practices (MAPs) for ADHD (Zylowska et al., 2008), while our own pilot study (Hepark, Kan, & Speckens, 2014) used an adapted and extended 10-week mindfulness-based cognitive therapy (MBCT) program (Segal, Williams, & Teasdale, 2002). Both the MAPs and the adapted MBCT programs consisted of mindfulness exercises and didactic teaching about ADHD. An important difference between both programs is that in the MAPs program, the duration of the meditation exercises increased from 5 to 15 min, while in the adapted MBCT program, the duration ranged from 3 to 30 min. All the above-mentioned studies observed a significant reduction of clinician-rated and/or self-reported ADHD symptoms (Hepark et al., 2014; Mitchell et al., 2017; Zylowska et al., 2008), and one of them observed improvements in clinician-rated and/or self-reported executive functioning (Mitchell et al., 2017). In addition to this, Mitchell et al. (2017) found significant improvements in the ability to self-regulate emotional functioning, and Zylowska et al. (2008) found a reduction of depressive and anxiety symptoms. In our own pilot study, significant improvements in self-reported patient functioning and task performance measuring attentional conflict (resolving conflict among responses; Fan, McCandliss, Sommer, Raz, & Posner, 2002) were observed (Hepark et al., 2014). This latter result is consistent with the significant improvements in tasks measuring attentional conflict found by Zylowska et al. (2008). Contrary to the other two pilot studies, Mitchell et al. (2017) did not find improvements in various tasks measuring executive functioning.

Although these pilot studies generally support the feasibility and effectiveness of mindfulness training in adults with ADHD, all three studies have small sample sizes, and two of them were uncontrolled. Therefore, a larger randomized controlled trial is required. We have developed a treatment protocol of mindfulness training for adults with ADHD mainly based on the MBCT protocol (Segal et al., 2002). In recent years, the MBCT has been demonstrated to be an effective intervention, particularly in reducing relapse in recurrent depression (Piet & Hougaard, 2011). The primary aim of this study was to investigate the effectiveness of adapted MBCT in adults with ADHD on their core symptoms. In addition, we conducted an exploratory investigation of the effectiveness of MBCT in executive functioning, depression and anxiety, patient functioning, and mindfulness skills. We also examined whether the effects of MBCT can be attributed to changes in mindfulness skills. We hypothesized that mindfulness training would lead to improvements in core symptoms and executive functioning in comparison with the waiting list (WL) group and that these effects are attributed to changes in mindfulness skills.

## Method

### *Participants*

The sample was composed of adults aged 18 to 65 years, receiving treatment for ADHD at the specialized outpatient clinic for adults with developmental disorders of the Department of Psychiatry at Radboud University Nijmegen Medical Center. Inclusion criteria were a primary diagnosis of ADHD according to the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*;

APA, 2000). The Dutch instrument *Diagnostic Interview for ADHD in Adults* (Kooij & Francken, 2007) was used as a diagnostic measure. Patients with all subtypes of ADHD according to this manual were included in the study. Exclusion criteria were as follows: (a) substance abuse/dependence within the last 6 months, (b) comorbid psychotic disorders, (c) borderline- and/or antisocial personality disorders, (d) learning difficulties, (e) chronic suicidality, and (f) automutilation. As part of the common clinical routine at the Radboudumc outpatient pansion partment of psychiatry, each patient was assessed with the psychiatric structured diagnostic interview (MINI-Plus; Van Vliet & De Beurs, 2007). This information was used to establish whether patients met exclusion criteria (a), (b), and (e) at that moment. Criteria (c), (d), and (f) were established by checking the available information in the electronic patient records. Stimulant medication dosage had been stabilized for 2 weeks prior to participation and non-stimulant medication for 4 weeks. The study was ethically approved by the committee on research involving human subjects (CMO), Arnhem-Nijmegen 2009/021, ABRnr: NL25483.091.09.

## Procedure

Patients were recruited at the specialist ADHD service of the Radboudumc outpatient department of psychiatry, where approximately 300 patients are assessed with respect to ADHD each year. Pharmacotherapy and participation in a psycho-educational ADHD program were usually offered first to patients who were diagnosed with ADHD; the psycho-educational program following the initiation of pharmacotherapy after 3 months on average. During the subsequent treatment period, eligible patients with ADHD were invited by their therapists (three psychiatrists, two psychologists, and one specialist registered nurse) to participate in the trial. Interested patients were interviewed by the researcher to assess inclusion and exclusion criteria and were asked for informed consent. Participants were randomly allocated to mindfulness training (MBCT) or WL control condition by an independent researcher. All patients in both conditions were asked to keep their ADHD medication stable during the study. The WL group and MBCT group were not allowed to participate in other group interventions, such as a psycho-education group or a cognitive behavioral therapy (CBT) group. After 3 months, patients allocated to the WL condition were offered MBCT as well. For patients of the MBCT group, self-report questionnaires and a clinical interview were administered prior to the first mindfulness session and after the last session. For patients in the WL group, the same outcome measures were administered with a time interval of 12 weeks. The clinical interviews were conducted single blindly by a psychiatrist. In a subsample of 50 persons of both MBCT and WL groups, electroencephalogram (EEG) was conducted prior to and after the research period. These findings were reported in a separate paper (Schoenberg et al., 2014).

## Intervention

The mindfulness training was adapted from the MBCT protocol developed for recurrent depression (Segal et al., 2002). The frequency of the sessions was extended from 8 to 12 weekly sessions to offer more repetition of both exercises and didactic teaching, because of common deficits in executive functioning in patients with ADHD (Willcutt et al., 2005). The duration of the sessions was extended with a break of 15 to 30 min halfway the session to make it easier for patients to sustain their attention during the meeting. In line with the original MBCT program, one guided silent practice session was included. The psycho-education sections about depression were replaced by psycho-education about ADHD, consisting of (a) neurobiology of ADHD, (b) coping with symptoms of ADHD, and (c) ways to integrate mindfulness in daily life. During the first sessions of the training, patients were invited to explore ways of Support (e.g., asking your partner to remind you), Structure (e.g., practicing at a fixed time), and Strategy (e.g., setting an alarm) to find ways to develop a daily routine to practice. In accordance with the MBCT during subsequent sessions, the following themes were discussed: automatic pilot, dealing with barriers, mindfulness of the breath, staying present, allowing and letting be, thoughts are not facts, taking care of yourself and using what you have learned. Contrary to the MBCT program, the duration of meditation exercises was built up more gradually. Some aspects of the MAPs developed by Zylowska et al. (2008) were included: mindful awareness of music, psycho-education about the different facets of attention (alerting: achieving and maintaining an alert state, orienting: selection of information from sensory output, and conflict: resolving conflict among responses; Fan et al., 2002) and mindful listening (listen with focused attention, not interrupting the speaker, and noticing distractions) and speaking (speak with focused attention, verbalizing the current experience, noticing the tendency to go off a topic). Participants received workbooks and CDs to support home practice, that is, approximately 30 min of self-practice each day with increasing duration. The MBCT groups were instructed by two experienced mindfulness teachers: a psychiatrist specialized in ADHD with 10 years of experience as a mindfulness teacher (S.H.) and a qualified nurse specialist meeting the advanced criteria of the Association of Mindfulness-Based Teachers in the Netherlands and Flanders (M.S.), which include (a) a minimum of 150 hr of education in a mindfulness-based stress reduction (MBSR)/MBCT background and theory, including a reflection report; (b) relevant professional training; (c) a minimum of 3 years of practicing meditation regularly and attending retreats; (d) having attended MBSR/MBCT

as a participant; (e) continued training; and (f) giving a minimum of two courses every 2 years.

## Measures

*Screening and diagnostic measure.* The *Diagnostic Interview for ADHD in Adults* (Kooij & Francken, 2007) is a semi-structured interview, consisting of two parts: all 18 ADHD symptoms according to the *DSM-IV-TR* criteria in childhood and at present; and impairment in functioning on work, education, family, social/relationships and self-confidence due to ADHD symptoms in both childhood and adulthood.

*Primary outcome measure.* ADHD symptoms were assessed by a clinician with the investigator rating version of the Conners' Adult ADHD Rating Scale (CAARS-INV; Conners, Erhardt, & Sparrow, 1999). The CAARS-INV consists of 30 items, which are rated on a 4-point Likert-type scale. Responses to the CAARS-INV can be organized to yield a Total ADHD Symptoms score, an Inattention score, and a Hyperactivity/Impulsivity score. It has shown good internal consistency and inter-rater reliability, as well as sensitivity to treatment outcome (Adler et al., 2008). Cronbach's α coefficients varied from .74 to .94, and intraclass correlations between investigator ratings and self-ratings ranged from .45 to .87.

*Secondary outcome measures.* The self-report version of the Conners' Adult ADHD Rating Scale (CAARS-S; Conners et al., 1999) consists of 30 items, which are rated on a 4-point Likert-type scale. The psychometric properties of the CAARS-S are similar to the investigator rating version of this questionnaire, and Cronbach's α coefficients varied from .76 to .95 (Adler et al., 2008).

Executive functioning was assessed using the Behavior Rating Inventory of Executive Function–Adult Self-Report version (BRIEF-ASR; Roth, Isquith, & Gioia, 2005). The BRIEF-ASR consists of 75 items and nine scales, which are rated on a 3-point Likert-type scale: Inhibit, Shift, Emotional Control, Self-Monitor, Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials. It includes three validity scales: Negativity, Infrequency, and Inconsistency. For the Dutch version of the BRIEF-ASR internal consistency with Cronbach's α coefficients ranging from .70 to .89 and test–retest reliability with Pearson's *r* of .70 or higher were found (Scholte & Noens, 2011).

The Beck Depression Inventory (BDI-II-NL; Beck, Steer, & Brown, 1996) was used to assess the possible presence of depression symptoms. The BDI is self-administered and contains 21 items, which are scored on a 4-point Likert-type scale. The BDI has shown high internal consistency, high reliability, and improved concurrent, content, and structural validity. Cronbach's α coefficients ranged from .83 to .96, and test–retest reliability with Pearson's *r* varied from .73 to .96 (Wang & Gorenstein, 2013).

To measure levels of state and trait anxiety, the Dutch version of the State-Trait Anxiety Inventory (STAI; Van der Ploeg, 2000) was administered. The STAI consists of 20-item self-report statements describing how people feel at a particular moment (state) and 20 items with a description of general feelings of anxiety (trait). The English version of the STAI showed positive psychometric features, with generally satisfactory internal consistency and test–retest reliability. Cronbach's α coefficients ranged from .65 to .96 for state anxiety and from .72 to .96 for trait anxiety. Test–retest reliability was most stable for trait anxiety with Pearson's *r* ranging from .82 to .94, compared with values between .34 and .96 for state anxiety (Barnes, Harp, & Jung, 2002).

Patient functioning was measured with the Dutch version of the Outcome Questionnaire (OQ 45.2; Lambert et al., 1996). The OQ consists of 45 items, which are scored on a 5-point Likert-type scale. The OQ is a multi-trait scale consisting of three subscales: Subjective Distress, Interpersonal Relations, and Social Role. The OQ has good psychometric properties, including an excellent internal consistency and adequate test–retest reliability. Cronbach's α coefficients ranged from .70 to .93, and test–retest reliability with Pearson's *r* varied from .78 to .84 (Vermeersch, Lambert, & Burlingame, 2000). The psychometric properties of the Dutch version are similar to the original version of the OQ with Cronbach's α coefficients between .69 and .93 and Pearson's *r* from .70 to .83 in a clinical population (de Jong et al., 2007).

Mindfulness skills were assessed with the Dutch translation of the Kentucky Inventory of Mindfulness Skills (KIMS; Baer, Smith, & Allen, 2004). The KIMS is a 39-item self-report inventory consisting of four mindfulness skills: observing, describing, acting with awareness, and acceptance without judgment. The KIMS has good internal consistency and adequate to good test–retest reliability. Cronbach's α coefficients varied from .72 to .88 (Baum et al., 2010) and Pearson's *r* ranged from .65 to .86 (Baer et al., 2004).

## Sample Size

The power calculation was based on the pilot study of Zylowska et al. (2008). Using a two-sided test with an alpha of .05 and a power of 0.80, approximately 40 patients per arm were required. Considering a drop-out percentage of 20%, 50 patients were required for each group with a total of 100 patients.

## Statistical Analysis

*Differences between MBCT and waitlist at end of treatment.* An ANCOVA was used to compare post-treatment between the two groups, adjusted for baseline levels of symptoms (as covariate). A Cohen's *d*-type effect size was calculated as the group difference at the end of treatment corrected for

baseline values divided by the pooled standard deviation at baseline. As unfortunately non-completers of the MBCT group were not invited to take part of the post-assessments, the primary analysis of the results was on a per-protocol (PP) basis. This analysis was done with all participants who attended six or more sessions in the MBCT group and all participants in the WL group. A secondary intention-to-treat (ITT) analysis was performed with imputation of missing data according to Last Observation Carried Forward (LOCF) to provide a more conservative estimate of the treatment effect. In addition, we calculated the number of responders, that is, patients who improved ≥30% in ADHD symptoms defined as a reduction in the CAARS-INV score.

*Moderation and mediation analysis.* Exploratory moderation analyses were conducted to examine whether psychotropic medication, gender, and age predicted treatment outcome. The moderation analysis with age as moderator was conducted with the PROCESS macro developed by Andrew Hayes (2012), and the analyses with use of medication and gender were conducted with an ANOVA. To explore whether a change in mindfulness skills explained the effect of the training on reduction of ADHD symptoms and improvements of executive functioning, a mediation analysis was conducted, following the assumptions proposed by Baron and Kenny (1986). The CAARS-INV and BRIEF-A difference scores were entered as dependent variables. The difference score on the subscales of the KIMS figured as mediators and condition as the independent variable. The model with the mediator was compared with the model without the mediator to investigate meditation effects. A bootstrap of 1,000 replications was employed. The mediation analyses were also conducted with the PROCESS macro. SPSS package 20.0.0 was used for the analyses.

## Results

### Study Population

In total, 103 adults were randomly allocated to the MBCT or waitlist conditions. One patient allocated to MBCT dropped out of the study before completing the baseline assessment. From two further patients (MBCT, $n = 1$; WL, $n = 1$), baseline assessments were completed, but got lost, so they could unfortunately not be included in any of the analyses. There were no significant differences in baseline characteristics between the MBCT and WL groups (see Table 1).

### Feasibility

Of the 53 patients randomized to the MBCT group, 12 (23%) did not complete the study, whereas 5 (11%) of 47 patients randomized to the WL group did not complete the post-assessments (see Figure 1). There was no significant difference in drop-out rates between the MBCT group and the WL group, $\chi^2(1, N = 100) = 2.62$, $p = .11$. Treatment completion was defined as having attended to at least six sessions. Patients who dropped out of the mindfulness training were not assessed at post-treatment. Therefore, only pre- and post-measurements from completers were available. No significant differences were found between completers and non-completers of the mindfulness training on age, sex, use of medication, and clinical characteristics at baseline, except for a trend for patients with more depressive symptoms to drop out more often, $t(93) = 1.78$, $p = .08$.

### Treatment Outcome (See Table 2)

*ADHD symptoms.* The MBCT group had less ADHD symptoms as rated by a clinician with the CAARS-INV, $F(1, 65) = 18.39$, $p < .01$, than those in the WL group. Significant differences were also found for the reduction of self-reported ADHD symptoms, $F(1, 71) = 10.91$, $p < .01$. Effect sizes were in the small to large range (Cohen's $d$ type = 0.39-.0.78).

ITT analysis still showed similar results for the primary outcome measure. A significantly greater reduction of investigator-rated ADHD symptoms was found in the MBCT group compared with the WL group, $F(1, 86) = 14.59$, $p < .01$, Cohen's $d$ type = 0.66. ITT analysis with self-reported ADHD symptoms as outcome measure also demonstrated comparable results, except for the subscale "Hyperactive-Impulsive Symptoms," $F(1, 93) = 3.16$, $p = .08$, Cohen's $d$ type = 0.26.

Regarding ADHD symptom reduction, 43.2% ($n = 16$) in the MBCT group improved more than 30% rated by an investigator in comparison with 0.03% ($n = 1$) in the WL group.

*Executive functioning.* The MBCT and WL groups also differed significantly in improvements in executive functioning, $F(1, 59) = 19.76$, $p < .01$. These differences applied to all the subscales with effect sizes varying from moderate to large (Cohen's $d$ type = 0.43-.0.93). An ITT analysis showed similar results, $F(1, 89) = 12.55$, $p < .01$, Cohen's $d$ type = 0.57.

*Depression and anxiety.* No significant differences between the groups were found in reduction of depressive, $F(1, 71) = 1.65$, $p = .20$, Cohen's $d$ type = 0.22, or anxiety symptoms, $F(1, 71) = 1.42$, $p = .24$, Cohen's $d$ type = 0.26.

*Patient functioning.* No significant differences between the groups were found in improvement of patient functioning, $F(1, 68) = 1.13$, $p = .29$, Cohen's $d$ type = 0.23.

*Mindfulness skills.* The MBCT and WL groups differed significantly in improvements in mindfulness skills, $F(1, 70) = 13.17$,

**Table 1.** Baseline Sociodemographic and Clinical Characteristics.

| | MBCT ($n$ = 55) | Waitlist ($n$ = 48) | $t$ test or $\chi_2$ | $p$ value |
|---|---|---|---|---|
| Demographic characteristics; *N* (%) | | | | |
| Female gender | 34 (62) | 22 (46) | 2.65[a] | .10 |
| Age; *M* (*SD*) | 36.5 (10) | 35.2 (9) | −0.66 | .51 |
| ADHD medication | | | 0.36[a] | .55 |
| Methylphenidate | 25 (46) | 17 (36) | | |
| Dextroamphetamine | 5 (9) | 7 (15) | | |
| Bupropion | 3 (6) | 1 (2) | | |
| Atomoxetine | — | 1 (2) | | |
| No medication | 22 (40) | 22 (46) | | |
| Clinical characteristics; *M* (*SD*) | | | | |
| ADHD symptoms, *CAARS investigator* | 29.3 (9.4) | 29.6 (7.5) | 0.19 | .85 |
| Inattention | 16.2 (5.2) | 17.4 (4.5) | 1.16 | .25 |
| Hyperactive-impulsive | 13.0 (5.8) | 12.2 (5.3) | −0.73 | .47 |
| ADHD symptoms, *CAARS self-report* | 28.3 (7.5) | 29.6 (7.0) | 0.87 | .39 |
| Inattention | 15.5 (4.3) | 16.3 (4.5) | 0.89 | .38 |
| Hyperactive-impulsive | 12.8 (5.1) | 13.3 (4.7) | 0.48 | .63 |
| Executive functioning, *BRIEF-ASR* | 150.1 (24.2) | 155.6 (17.6) | 1.22 | .23 |
| Depression, *BDI* | 13.0 (9.4) | 13.4 (8.1) | 0.24 | .81 |
| Anxiety, *STAI* | 90.3 (19.6) | 96.4 (17.9) | 1.57 | .12 |
| Patient functioning, *OQ 45.2* | 67.3 (19.8) | 68.5 (17.8) | 0.29 | .77 |
| Mindfulness skills, *KIMS* | 72.5 (17.1) | 70.8 (14.5) | −0.52 | .60 |

*Note.* CAARS = Conners' Adult ADHD Rating Scale; BRIEF-ASR = Behavior Rating Inventory of Executive Function-Adult Self-Report Version; BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; OQ = Outcome Questionnaire; KIMS = Kentucky Inventory of Mindfulness Skills.
[a]Chi-square.

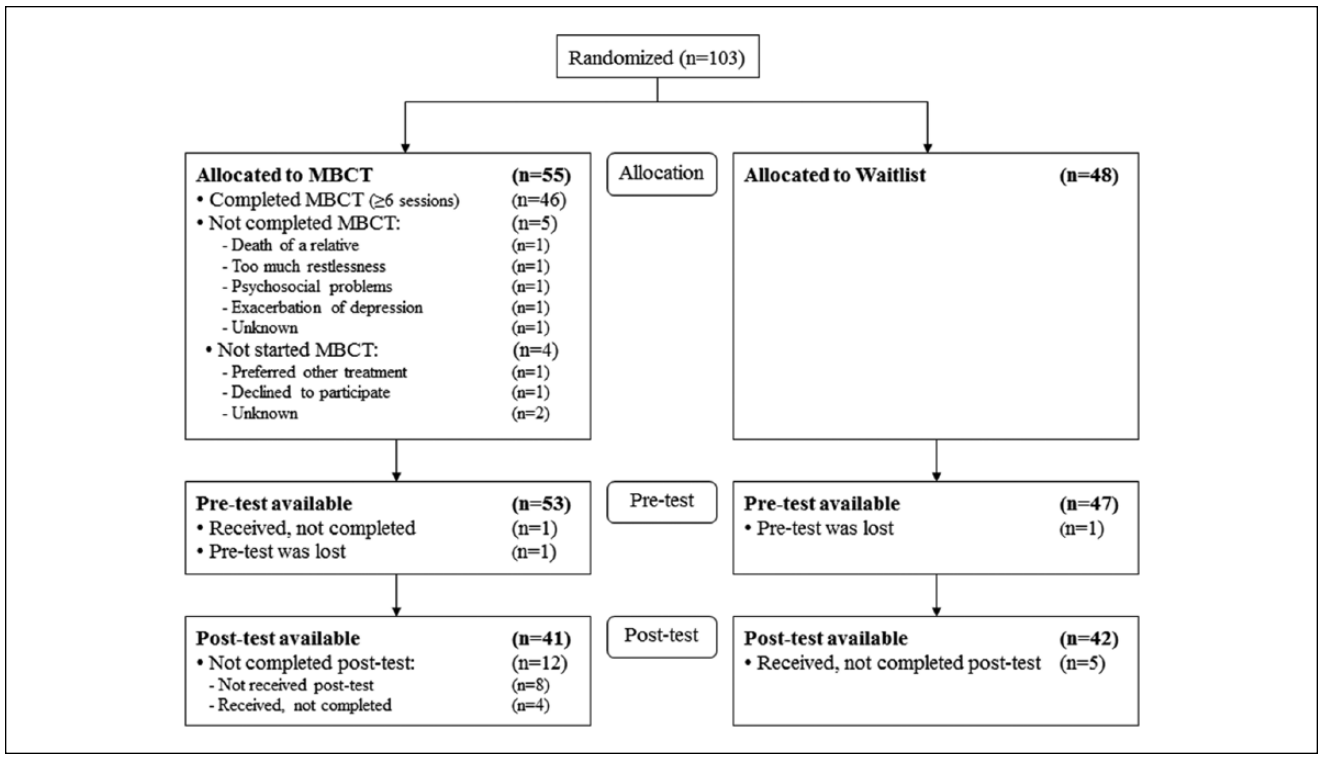


**Figure 1.** Flowchart.
*Note.* MBCT = mindfulness-based cognitive therapy.

**Table 2.** Differences Between Groups at the End of Treatment, Controlling for Baseline Levels.

| | Baseline | | End of treatment | | End of treatment | |
|---|---|---|---|---|---|---|
| | MBCT | WL | MBCT | WL | Group difference [95% CI][a] | Cohen's *d* type |
| ADHD symptoms, *CAARS* | | | | | | |
| Investigator (*n* = 68) | | | | | | |
| Inattention | 16.3 (4.7) | 17.0 (4.5) | 12.4 (4.6) | 16.5 (4.2) | −3.6 [−5.5, −1.8]** | 0.78 |
| Hyperactive-impulsive | 13.0 (5.6) | 12.0 (4.8) | 9.0 (4.6) | 11.5 (5.3) | −3.2 [−5.0, −1.4]** | 0.62 |
| Total score | 29.3 (8.7) | 29.0 (7.1) | 21.5 (7.7) | 28.0 (7.5) | −6.7 [−9.8, −3.6]** | 0.85 |
| Self report (*n* = 74) | | | | | | |
| Inattention | 15.4 (3.9) | 16.6 (4.5) | 12.8 (4.2) | 16.1 (3.8) | −2.7 [−4.3, −1.2]** | 0.64 |
| Hyperactive-impulsive | 12.8 (4.8) | 13.6 (4.5) | 10.3 (4.2) | 12.6 (5.0) | −1.8 [−3.4, −0.2]** | 0.39 |
| Total score | 28.2 (7.0) | 30.2 (6.5) | 23.0 (7.3) | 28.8 (6.9) | −4.5 [−7.3, −1.8]** | 0.67 |
| EF, *BRIEF-ASR* (*n* = 74) | | | | | | |
| Inhibit | 17.2 (3.3) | 18.2 (2.6) | 14.7 (3.1) | 17.4 (3.2) | −2.1 [−3.3, −0.9]** | 0.71 |
| Shift (*n* = 62) | 12.6 (2.9) | 12.5 (2.5) | 11.1 (3.0) | 12.3 (3.0) | −1.3 [−2.2, −0.3]** | 0.48 |
| Emotional control | 19.5 (5.1) | 19.1 (5.1) | 17.1 (4.7) | 18.8 (4.9) | −2.2 [−3.8, −0.6]** | 0.43 |
| Self-monitor | 11.4 (2.7) | 11.4 (2.8) | 10.1 (2.5) | 11.3 (2.8) | −1.3 [−2.3, −0.3]** | 0.47 |
| Initiate | 17.4 (3.9) | 18.4 (3.2) | 15.7 (4.4) | 18.1 (2.9) | −1.6 [−2.8, −0.4]** | 0.45 |
| Working memory | 19.4 (3.0) | 19.8 (2.2) | 17.2 (3.4) | 19.2 (2.6) | −1.7 [−2.9, −0.5]** | 0.65 |
| Plan/organize | 23.0 (4.0) | 24.5 (3.6) | 19.8 (4.9) | 24.1 (3.5) | −3.1 [−4.7, −1.5]** | 0.82 |
| Task monitor | 13.1 (2.6) | 13.7 (2.3) | 11.6 (2.4) | 13.5 (2.6) | −1.5 [−2.4, −0.6]** | 0.61 |
| Organization of materials | 17.6 (4.2) | 19.1 (3.6) | 15.1 (4.2) | 18.8 (4.1) | −2.4 [−3.5, −1.2]** | 0.62 |
| Total score | 150.3 (22.2) | 156.7 (17.2) | 132.2 (26.4) | 153.8 (18.8) | −18.4 [−26.6, −10.1]** | 0.93 |
| Depression, *BDI* (*n* = 74) | 12.1 (8.7) | 13.2 (8.3) | 9.1 (7.8) | 11.8 (9.8) | −1.9 [−4.8, 1.0] | 0.22 |
| Anxiety, *STAI* (*n* = 74) | 89 (18.0) | 97.2 (18.5) | 78.5 (22.0) | 90.8 (25.6) | −4.8 [−12.9, 3.3] | 0.26 |
| Patient functioning, *OQ 45.2* (*n* = 71) | 66.3 (17.8) | 69.1 (17.5) | 60.2 (19.8) | 66.6 (24.0) | −4.1 [−11.8, 3.6] | 0.23 |
| Mindfulness skills, *KIMS* (*n* = 73) | | | | | | |
| Observe | 20.8 (8.3) | 19.1 (6.3) | 24.3 (7.2) | 19.2 (6.9) | 4.2 [1.4, 6.9]* | 0.57 |
| Describe | 18.2 (6.0) | 17.8 (5.4) | 19.5 (5.3) | 19.1 (6.5) | 0.2 [−1.6, 2.1] | 0.04 |
| Act With Awareness | 12.8 (4.6) | 12.7 (5.0) | 17.3 (5.9) | 12.5 (5.2) | 4.5 [2.1, 6.9]* | 0.94 |
| Accept without judgment | 20.0 (6.4) | 19.5 (7.4) | 22.2 (6.6) | 19.5 (7.7) | 2.5 [−0.4, 5.5] | 0.36 |
| Total score | 71.8 (14.5) | 69.1 (12.5) | 83.3 (17.1) | 70.2 (12.7) | 11.6 [5.2, 18.0]* | 0.86 |

*Note.* MBCT = mindfulness-based cognitive therapy; WL = waiting list; CI = confidence interval; CAARS = Conners' Adult ADHD Rating Scale; EF = executive function; BRIEF-ASR = Behavior Rating Inventory of Executive Function-Adult Self-Report Version; BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; OQ = Outcome Questionnaire; KIMS = Kentucky Inventory of Mindfulness Skills.

[a]Differences between conditions, corrected for baseline values.

*Statistical significant difference for <.05.**Statistical significant difference for <.01.

$p < .05$. These differences applied to the subscales "Observe" and "Act With Awareness" with moderate to large sizes (Cohen's *d* type) varying from 0.57 to .0.94. An ITT analysis also demonstrated a significant effect of mindfulness skills, $F(1, 92) = 7.30$, $p < .01$, Cohen's *d* type = 0.54.

## *Moderation and Mediation Analyses (See Figure 2)*

Treatment outcome did not appear to be predicted by the use of psychotropic medication, $F(1, 73) = 0.07$, $p = .79$; gender, $F(1, 73) = 0.60$, $p = .44$; or age ($\beta = -.24$, 95% CI = [−0.64, 0.15], $t = -1.22$, $p = .23$), indicating that the effectiveness of MBCT in reducing ADHD symptoms was independent of these factors.

We explored whether the difference scores of the significant subscales of the KIMS, which are "Observe" and "Act With Awareness," had a mediating effect on the relationship between group allocation and the ADHD difference scores measured with the CAARS-INV. The Mindfulness skills "Observe," $\beta = 4.29$, 95% CI = [0.65, 7.93] and "Act With Awareness," $\beta = 3.90$, 95% CI = [0.74, 7.06] were both related to condition, suggesting that patients in the MBCT group reported a greater improvement in these mindfulness skills than the WL group. ADHD difference scores were related to difference in "Act With Awareness," $\beta = -.58$, 95% CI = [−0.88, −0.29], but not to difference in "Observe," $\beta = -.27$, 95% CI = [−0.55, 0.01]. This indicates that only an improvement in "Act With Awareness" was associated with a reduction of investigator-rated ADHD symptoms. The $\beta$ between condition and ADHD difference scores, without a mediator, was −6.08, 95% CI = [−10.02, −2.14].

Adding "Act With Awareness" as a mediator between group allocation and ADHD difference scores showed a partial

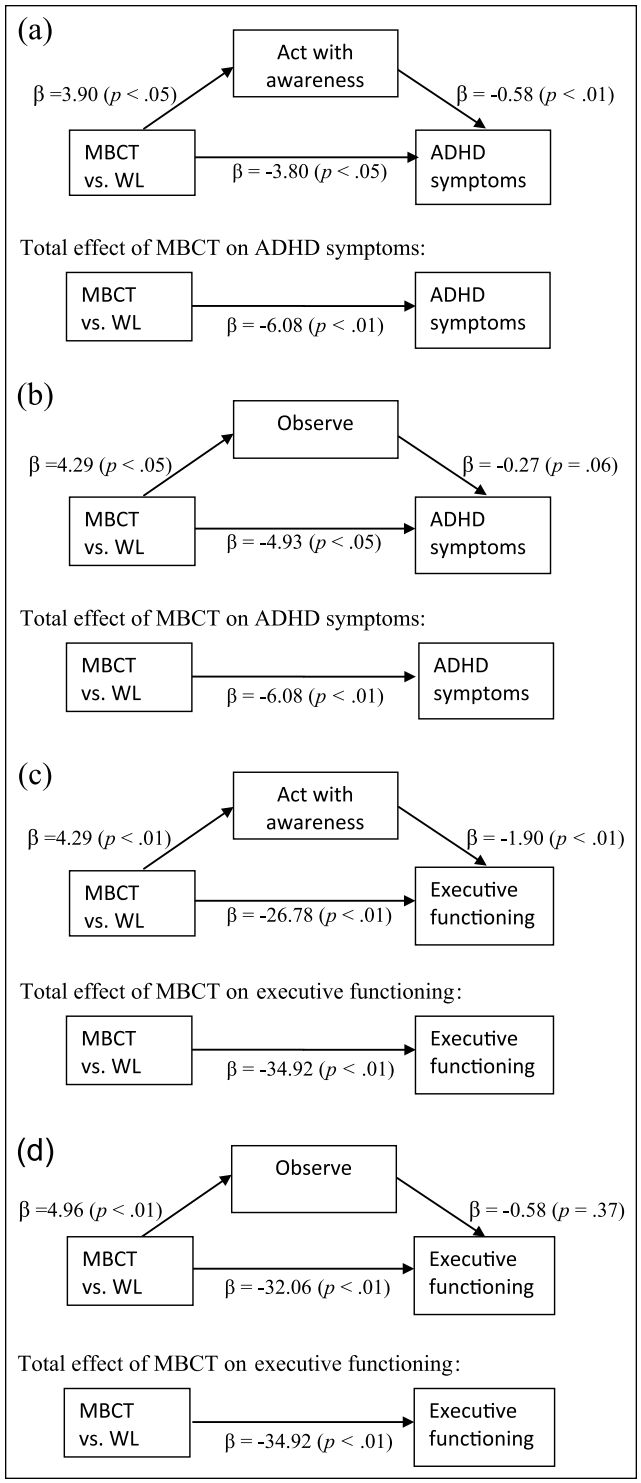


**Figure 2.** Mediation and non-mediation analyses with ADHD symptoms (a), (b) and executive functioning (c), (d) as outcome.
*Note.* MBCT = mindfulness-based cognitive therapy; WL = waiting list.

mediating effect, β = −3.80, 95% CI = [−7.50, −0.11], meaning a smaller β and a smaller but significant *p* value compared with the model without the mediator. We bootstrapped the indirect effect of condition on ADHD difference scores with 1,000 samples, which showed a significant indirect effect for "Act With Awareness": point estimate = −2.27, 95% CI = [−5.75, −0.35].

Given that group allocation had a highly significant effect on the BRIEF-ASR, and the BRIEF-ASR has a considerable overlap with the CAARS, a possible mediating effect of the mindfulness skills "Observe" and "Act With Awareness" on the relationship between group allocation and executive functioning was investigated. As reported above, "Observe" and "Act With Awareness" were related to condition. The relationship between condition and BRIEF-ASR difference scores, without a mediator, yielded β = −34.92, 95% CI = [−51.78, −18.07]. Adding "Observe" and "Act With Awareness" as mediators between group allocation and BRIEF-ASR difference scores showed a partial mediating effect for "Act With Awareness," β = −26.78, 95% CI = [−43.72, −9.83], but no mediating effect for "Observe." The indirect effect of condition on BRIEF-ASR difference scores was bootstrapped with 1,000 samples and showed a significant indirect effect for the mindfulness skill "Act With Awareness": point estimate = −8.15, 95% CI = [−20.73, −0.98].

## Discussion

In this study, we found that adapted MBCT for ADHD resulted in a significant reduction of investigator-rated and self-reported ADHD symptoms in comparison with a WL group. Moreover, the treatment resulted in significant improvements of executive functioning and overall mindfulness skills. Similar results were found in the more conservative ITT analyses with still moderate effect sizes, except for self-reported hyperactive-impulsive symptoms. This shows the robustness of most of the found effects. Contrary to our expectations, MBCT did not have an effect on patient functioning, depressive and anxiety symptoms in this particular population.

We found partial mediating effects of the mindfulness skill "Act With Awareness" on the relationship between condition and ADHD symptoms and on the relationship between condition and executive functioning. This suggests that the efficacy of MBCT in reducing ADHD symptoms and improving executive functioning is partially mediated by an increase of "Act With Awareness," that is, the ability to engage fully in activities in the present moment (Baum et al., 2010). This is consistent with the results of previous studies, which indicate consistent and moderate evidence for mindfulness skills as mediators on mental health outcomes (Gu, Strauss, Bond, & Cavanagh, 2015).

The observed reduction of ADHD symptoms and improvement of executive functioning observed by clinicians and/or patients themselves are in line with the results of previous pilot studies (Hepark et al., 2014; Mitchell

et al., 2013; Zylowska et al., 2008), and these results strengthen the assumption that mindfulness can be an effective psychosocial intervention for adults with ADHD to deal with core symptoms, such as inattention, hyperactivity, and impulsivity.

In contrast with Zylowska et al. (2008), we did not find a substantial reduction of depressive and anxiety symptoms. This might be partly explained by differences in baseline levels between both samples. In our sample, baseline levels of depressive symptoms were rather low, while in the study sample of Zylowska and colleagues, they were substantially higher. Furthermore, although we did find significant improvements in patient functioning in our earlier pilot study (Hepark et al., 2014), in the current larger study, we did not. It might take more time for reductions of ADHD symptoms to result in improvements in overall functioning and comorbid symptoms. Emilsson et al. (2011) found, for instance, that the treatment effect of CBT on social functioning, comorbid depressive, and anxiety symptoms became greater over time in adults with ADHD.

To our knowledge, this is the first larger randomized controlled trial investigating the efficacy of mindfulness training in adults with ADHD, which makes use of blinded outcome assessments. Contrary to the pilot studies of Zylowska et al. (2008) and Mitchell et al. (2017), this study assessed the effectiveness of mindfulness training based on the MBCT protocol (Segal et al., 2002) rather than a newly developed mindfulness training like the MAPs protocol (Zylowska, Smalley, & Schwartz, 2009). MBCT has already been demonstrated to be an effective intervention in different areas, for example, in reducing relapse in recurrent depression (Piet & Hougaard, 2011). When comparing our study with prior research in this area, it should be noted that the MAPs training consists of 20 hr of mindfulness training, whereas the adapted MBCT for ADHD consisted of 36 hr. Furthermore, there are additional differences between the curricula of MAPs and MBCT, for example, in amount and content of psycho-education and duration of formal practices, so the different studies should be compared with caution.

Although this study yields interesting findings, some important limitations should be considered. First, drop-out rates in both MBCT and WL groups were substantial, and outcome data were not available for drop-outs, leading to a PP analysis in a smaller sample than the proposed sample size. It is quite probable that ADHD-related characteristics of this specific patient group (such as dysfunctional cognitions decreasing motivation and increasing procrastination, forgetfulness, difficulties with sticking to daily routines, coming too late) contributed to the high drop-out rates of both treatment and assessments. As a result, treatment effects could have been overestimated as they only applied to patients who attended at least six MBCT sessions. To provide a more conservative estimate of the treatment effect, we performed ITT analyses with imputation of missing data according to LOCF. In addition, the smaller sample size at the end of the study might have led to Type II errors, that is, not establishing differences that were present, due to insufficient power. A second limitation of this study is the lack of a follow-up period, so long-term effects of the treatment were not considered. A third limitation is that the current research did not take into account comorbidity with other psychiatric disorders, despite the considerable amount of literature documenting the comorbidity between ADHD and, for example, mood disorders, substance abuse, and personality disorders (Kessler et al., 2006). Future research should include a full psychiatric assessment of patients allowing for an investigation of the possible moderation of treatment effectiveness by comorbid psychiatric disorders. A fourth limitation is that interrater reliability of the CAARS-INV is not measured, so no information is available about the degree to which different raters have given consistent estimates of ADHD symptoms at a certain point in time. A last limitation is that due to the fact that only pre- and post-levels of symptoms and mediators were available, it was not possible to take account of the temporal ordering of mediator and outcome variables in the mediation analyses. Future research should take better account of temporality on order to draw firmer conclusions about causality.

To conclude, this study provides promising support for the effectiveness of adapted mindfulness training for adults with ADHD, suggesting that this intervention can be a valuable addition to the therapeutic arsenal of evidence-based interventions for adult ADHD. This might be particularly useful for patients for whom the effect of pharmacological treatment is insufficient or who are not willing to take medication. Some modifications may be needed to reduce drop-out, for example, by making use of sms alerts as a reminder for training sessions and actively contacting participants by phone in case of no shows. Furthermore, larger trials are needed, including longer-term follow-up assessments, to evaluate a possible later effect on patient functioning and the stability of treatment effect. To enhance generalizability of the results, a multicenter trial is recommended. Finally, cost-effectiveness analysis should be included as a valuable means to assess whether additional mindfulness training is cost-effective compared with treatment as usual.

## Acknowledgments

We would like to thank Jan Leijtens for his assistance with data collection and Geert Schattenberg for data management. We also would like to thank Marleen Schouten for her willingness to cooperate in this research project as a mindfulness teacher.

## Authors' Note

Sevket Hepark and Lotte Janssen are joint first authors.

## Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Cornelis C. Kan has also been a member of the advisory board and consultancy team of Eli Lilly BV and was a speaker at the Adult-ADHD Academy of Eli Lilly. The other authors declared that they have no potentional conflicts of interest with respect to the research, authorshop, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## References

Adler, L. A., Faraone, S. V., Spencer, T. J., Michelson, D., Reimherr, F. W., Glatt, S. J., . . . Biederman, J. (2008). The reliability and validity of self-and investigator ratings of ADHD in adults. *Journal of Attention Disorders*, *11*, 711-719. doi:10.1177/1087054707308503

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Washington, DC: Author.

Baer, R. A., Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment*, *11*, 191-206. doi:10.1177/1073191104268029

Barkley, R. A., & Murphy, K. R. (2010). Impairment in occupational functioning and adult ADHD: The predictive utility of executive function (EF) ratings versus EF tests. *Archives of Clinical Neuropsychology*, *25*, 157-173. doi:10.1093/arclin/acq014

Barnes, L. L. B., Harp, D., & Jung, W. S. (2002). Reliability generalization of scores on the Spielberger state-trait anxiety inventory. *Educational and Psychological Measurement*, *62*, 603-618. doi:10.1177/0013164402128775049

Baron, R. M., & Kenny, D. A. (1986). The moderator mediator variable distinction in social psychological-research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182. doi:10.1037/0022-3514.51.6.1173

Baum, C., Kuyken, W., Bohus, M., Heidenreich, T., Michalak, J., & Steil, R. (2010). The psychometric properties of the Kentucky inventory of mindfulness skills in clinical populations. *Assessment*, *17*, 220-229. doi:10.1177/1073191109356525

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Corporation.

Biederman, J., Petty, C. R., Fried, R., Kaiser, R., Dolan, C. R., Schoenfeld, S., . . . Faraone, S. V. (2008). Educational and occupational underattainment in adults with attention-deficit/hyperactivity disorder: A controlled study. *Journal of Clinical Psychiatry*, *69*, 1217-1222.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230-241. doi:10.1093/clipsy/bph077

Conners, C. K., Erhardt, D., & Sparrow, E. (1999). *CAARS adult ADHD rating scales-Technical Manual*. Toronto, Ontario, Canada: Multi-Health Systems.

de Graaf, R., Kessler, R. C., Fayyad, J., ten Have, M., Alonso, J., Angermeyer, M., . . . Posada-Villa, J. (2008). The prevalence and effects of adult attention-deficit/hyperactivity disorder (ADHD) on the performance of workers: Results from the WHO World Mental Health Survey Initiative. *Occupational & Environmental Medicine*, *65*, 835-842. doi:10.1136/oem.2007.038448

de Jong, K., Nugter, M. A., Polak, M. G., Wagenborg, J. E. A., Spinhoven, P., & Heiser, W. J. (2007). The Outcome Questionnaire (OQ-45) in a Dutch population: A cross-cultural validation. *Clinical Psychology & Psychotherapy*, *14*, 288-301. doi:10.1002/cpp.529

Eakin, L., Minde, K., Hechtman, L., Ochs, E., Krane, E., Bouffard, R., . . . Looper, K. (2004). The marital and family functioning of adults with ADHD and their spouses. *Journal of Attention Disorders*, *8*, 1-10.

Emilsson, B., Gudjonsson, G., Sigurdsson, J. F., Baldursson, G., Einarsson, E., Olafsdottir, H., & Young, S. (2011). Cognitive behaviour therapy in medication-treated adults with ADHD and persistent symptoms: A randomized controlled trial. *BMC Psychiatry*, *11*, Article 116.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, *14*, 340-347. doi:10.1162/089892902317361886

Faraone, S. V., & Glatt, S. J. (2010). A comparison of the efficacy of medications for adults attention-deficit/hyperactivity disorder using meta-analysis of effect sizes. *The Journal of Clinical Psychiatry*, *71*, 754-763.

Fischer, M., Barkley, R. A., Smallish, L., & Fletcher, K. (2007). Hyperactive children as young adults: Driving abilities, safe driving behavior, and adverse driving outcomes. *Accident Analysis & Prevention*, *39*, 94-105. doi:10.1016/j.aap.2006.06.008

Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical Psychology Review*, *37*, 1-12. doi:10.1016/j.cpr.2015.01.006

Hayes, A. F. (2012). *PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling* [White paper]. Retrieved from http://www.afhayes.com/public/process2012.pdf

Hepark, S., Kan, C. C., & Speckens, A. (2014). Toepasbaarheid en effectiviteit van mindfulnesstraining bij volwassenen met AD(H)D; een open pilotonderzoek [Feasibility and effectiveness of mindfulness training in adults with ADHD: A pilot study]. *Tijdschrift voor Psychiatrie*, *56*, 471-476.

Hill, C. L., & Updegraff, J. A. (2012). Mindfulness and its relationship to emotional regulation. *Emotion*, *12*, 81-90.

Jha, A. P., Krompinger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive, Affective, & Behavioral Neuroscience*, *7*, 109-119. doi:10.3758/cabn.7.2.109

Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness

training on working memory capacity and affective experience. *Emotion*, *10*, 54-64. doi:10.1037/a0018438

Kabat Zinn, J. (2003). Mindfulness-based interventions in context: past, present, and future. *Clinical Psychology: Science and Practice*, *10*, 144-156.

Kessler, R. C., Adler, L., Ames, M., Barkley, R. A., Birnbaum, H., Greenberg, P., . . . Ustun, T. B. (2005). The prevalence and effects of adult attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *Journal of Occupational and Environmental Medicine*, *47*, 565-572. doi:10.1097/01.jom.0000166863.33541.39

Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., . . . Zaslavsky, A. M. (2006). The prevalence and correlates of adult ADHD in the United States: Results from the National Comorbidity Survey Replication. *American Journal of Psychiatry*, *163*, 716-723. doi:10.1176/appi.ajp.163.4.716

Kooij, J. J. S., & Francken, M. H. (2007). *Diagnostisch interview voor ADHD (DIVA) bij volwassenen* [Diagnostic Interview for ADHD in adults (DIVA)]. Retrieved from http://www.psyq.nl/Programma/Kenniscentrum-ADHD-bij-volwassenen

Lambert, M. J., Burlingame, G. M., Umphress, V., Hansen, N. B., Vermeersch, D. A., Clouse, G. C., & Yanchar, S. C. (1996). The Reliability and Validity of the Outcome Questionnaire. *Clinical Psychology & Psychotherapy*, *3*, 249-258. doi:10.1002/(sici)1099-0879(199612)3:4<249::aid-cpp106>3.0.co;2-s

Lara, C., Fayyad, J., de Graaf, R., Kessler, R. C., Aguilar-Gaxiola, S., Angermeyer, M., . . . Jin, R. (2009). Childhood predictors of adult ADHD: Results from the WHO World Mental Health (WMH) Survey Initiative. *Biological Psychiatry*, *65*, 46-54.

Lee, S. S., Humphreys, K. L., Flory, K., Liu, R., & Glass, K. (2011). Prospective association of childhood attention-deficit/hyperactivity disorder (ADHD) and substance use and abuse/dependence: A meta-analytic review. *Clinical Psychology Review*, *31*, 328-341. doi:10.1016/j.cpr.2011.01.006

Meszaros, A., Czobor, P., Balint, S., Komlosi, S., Simon, V., & Bitter, I. (2009). Pharmacotherapy of adult attention deficit hyperactivity disorder (ADHD): A meta-analysis. *International Journal of Neuropsychopharmacology*, *12*, 1137-1147. doi:10.1017/s1461145709990198

Mitchell, J. T., McIntyre, E. M., English, J. S., Dennis, M. F., Beckham, J. C., & Kollins, S. H. (2017). A pilot trial of mindfulness meditation training for ADHD in adulthood: Impact on core symptoms, executive functioning, and emotion dysregulation. *Journal of Attention Disorders*, *21*, 1105-1120. doi:10.1177/1087054713513328

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science*, *24*, 776-781. doi:10.1177/0956797612459659

NICE Guideline Attention Deficit Hyperactivity Disorder. (2013). *National institute of clinical excellence*. Retrieved from http://www.nice.org.uk/guidance/cg72

Ohlmeier, M. D., Peters, K., Kordon, A., Seifert, J., Wildt, B. T., Wiese, B., . . . Schneider, U. (2007). Nicotine and alcohol dependence in patients with comorbid attention-deficit/hyperactivity disorder (ADHD). *Alcohol and Alcoholism*, *42*, 539-543. doi:10.1093/alcalc/agm069

Piet, J., & Hougaard, E. (2011). The effect of mindfulness-based cognitive therapy for prevention of relapse in recurrent major depressive disorder: A systematic review and meta-analysis. *Clinical Psychology Review*, *31*, 1032-1040.

Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). *BRIEF-A: Behavior Rating Inventory of Executive Function-Adults version*. Lutz, FL: Psychological Assessment Resources.

Roth, R. M., Lance, C. E., Isquith, P. K., Fischer, A. S., & Giancola, P. R. (2013). Confirmatory factor analysis of the Behavior Rating Inventory of Executive Function-Adult version in healthy adults and application to attention-deficit/hyperactivity disorder. *Archives of Clinical Neuropsychology*, *28*, 425-434.

Schoenberg, P. L. A., Hepark, S., Kan, C. C., Barendregt, H. P., Buitelaar, J. K., & Speckens, A. E. M. (2014). Effects of mindfulness-based cognitive therapy on neurophysiological correlates of performance monitoring in adult attention-deficit/hyperactivity disorder. *Clinical Neurophysiology*, *125*, 1407-1416. doi:10.1016/j.clinph.2013.11.031

Scholte, E., & Noens, I. (2011). *BRIEF-A: Vragenlijst over executief functioneren bij volwassenen* [BRIEF-A: Questionnaire about executive functioning for adults]. Amsterdam, The Netherlands: Hogrefe.

Segal, Z., Williams, J., & Teasdale, J. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to relapse prevention*. New York, NY: Guilford Press.

Simon, V., Czobor, P., Balint, S., Meszaros, A., & Bitter, I. (2009). Prevalence and correlates of adult attention-deficit hyperactivity disorder: Meta-analysis. *British Journal of Psychiatry*, *194*, 204-211. doi:10.1192/bjp.bp.107.048827

Tuithof, M., Ten Have, M., van Dorsselaer, S., & de Graaf, R. (2014). Prevalence, persistency and consequences of ADHD in the Dutch adult population. *Tijdschrift Psychiatrie*, *56*, 10-19.

van den Hurk, P. A. M., Giommi, F., Gielen, S. C., Speckens, A. E. M., & Barendregt, H. P. (2010). Greater efficiency in attentional processing related to mindfulness meditation. *Quarterly Journal of Experimental Psychology*, *63*, 1168-1180. doi:10.1080/17470210903249365

Van der Ploeg, H. M. (2000). *Handleiding bij de Zelf-Beoordelings Vragenlijst* [Manual for the State-Trait Anxiety Inventory]. Amsterdam, The Netherlands: Harcout Assessment B.V.

Van Vliet, I., & De Beurs, E. (2007). Het Mini Internationaal Neuropsychiatrisch Interview (MINI). Een kort gestructureerd diagnostisch psychiatrisch interview voor DSM-IV en ICD-10 stoornissen [The Mini International Neuropsychiatric Interview (MINI). A short structured diagnostic psychiatric interview for DSM-IV and ICD-10 disorders]. *Tijdschrift voor Psychiatrie, 49*, 393-397.

Vermeersch, D. A., Lambert, M. J., & Burlingame, G. M. (2000). Outcome Questionnaire: Item sensitivity to change. *Journal of Personality Assessment*, *74*, 242-261. doi:10.1207/s15327752jpa7402_6

Verster, J. C., Bekker, E. M., de Roos, M., Minova, A., Eijken, E. J., Kooij, J. J. S., . . . Volkerts, E. R. (2008). Methylphenidate significantly improves driving performance of adults with attention-deficit hyperactivity disorder: A randomized crossover trial. *Journal of Psychopharmacology*, *22*, 230-237. doi:10.1177/0269881107082946

Wang, Y. P., & Gorenstein, C. (2013). Psychometric properties of the Beck Depression Inventory-II: A comprehensive review. *Revista Brasileira De Psiquiatria*, *35*, 416-431. doi:10.1590/1516-4446-2012-1048

Wigal, T., Brams, M., Gasior, M., Gao, J., Squires, L., Giblin, J., & 316 Study Group. (2010). Randomized, double-blind, placebo-controlled, crossover study of the efficacy and safety of lisdexamfetamine dimesylate in adults with attention-deficit/hyperactivity disorder: Novel findings using a simulated adult workplace environment design. *Behavioral and Brain Functions*, *6*, Article 34. doi:10.1186/1744-9081-6-34

Wilens, T. E., Morrison, N. R., & Prince, J. (2011). An update on the pharmacotherapy of attention-deficit/hyperactivity disorder in adults. *Expert Review of Neurotherapeutics*, *11*, 1443-1465. doi:10.1586/ern.11.137

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, *57*, 1336-1346. doi:10.1016/j.biopsych.2005.02.006

Zylowska, L., Ackerman, D. L., Yang, M. H., Futrell, J. L., Horton, N. L., Hale, T. S., . . . Smalley, S. L. (2008). Mindfulness meditation training in adults and adolescents with ADHD a feasibility study. *Journal of Attention Disorders*, *11*, 737-746. doi:10.1177/1087054707308502

Zylowska, L., Smalley, S. L., & Schwartz, J. M. (2009). *Mindful awareness and ADHD* (F. Didonna, Ed.). New York, NY: Springer.

## Author Biographies

**Sevket Hepark**, MD, is a psychiatrist at the out-patient clinic of the Radboud University Medical Center Nijmegen, specialized in care for adult patients with developmental disorders, such as ADHD and Autistic Spectrum Disorder (ASD), and personality disorders. He was the coordinator of this study.

**Lotte Janssen**, MSc, is a PhD student and coordinator of the project 'Aandacht voor ADHD' ['Attention for ADHD'], aimed at examining the (cost)effectiveness of MBCT versus treatment as usual in adults with ADHD at the Radboudumc Center for Mindfulness.

**Alicia de Vries**, MSc, is a PhD student at the Department of Health Sciences of the University Medical Center Groningen.

**Poppy L. A. Schoenberg**, PhD, is a research fellow with expertise in cognitive neuroscience, biological psychology and psychiatry.

**Rogier Donders**, PhD, is an biostatistician at the Department for Health Evidence of the Radboud University Medical Center Nijmegen.

**Cornelis C. Kan**, PhD, is a psychiatrist, senior researcher, university teacher and head of the outpatient Department of Psychiatry of the Radboud University Medical Center Nijmegen. His work in clinical practice and science is concerned with developmental disorders in adults such as ADHD and ASD.

**Anne E. M. Speckens**, PhD, is a professor of Psychiatry at the Radboud University Medical Center Nijmegen. She is the founder and clinical director of the Radboudumc Center for Mindfulness. The center provides mindfulness training for both clinical populations and professionals.