


A Randomized Controlled Trial of Mindfulness-Based Cognitive Therapy for College Students With ADHD

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Abstract

Objective: Between 2% and 8% of college students meet criteria for ADHD, with increased incidence in recent decades. There are very few clinical trials conducted on the meaningful intervention of ADHD in college. Mindfulness-based cognitive therapy (MBCT) effectively treats college students with ADHD and could be more feasibly applied in college mental health clinics. **Method:** Fifty-four undergraduates with ADHD between ages 19 and 24 were randomized to receive either MBCT or wait-list (WL) during a 6-week intervention phase. ADHD symptoms, neuropsychological performance, and related outcomes were assessed at pre-treatment, post-treatment, and 3-month follow-up. **Results:** Participants receiving MBCT group showed greater treatment response rates (57%-71% vs. 23%-31%) and experience less anxiety and depression, and greater levels of mindfulness; MBCT participants show greater improvement on neuropsychological performance. **Conclusion:** MBCT may be a useful intervention for college students with ADHD, improving participants' ADHD symptoms, mindfulness, and sustained attention. (*J. of Att. Dis.* XXXX; XX(X) XX-XX)

Keywords

adult ADHD treatment, college students, mindfulness-based cognitive therapy, Attentional Network Test

Introduction

Population surveys suggest that between 2% and 8% of college students meet criteria for ADHD (DuPaul, Weyandt, O'Dell, & Varejao, 2009; Weyandt & DuPaul, 2008, 2012). Because students with ADHD experience functional deficits related to decreases in attention, self-monitoring, and mood (Lewandowski, Lovett, Coddington, & Gordon, 2008), they tend to have lower grade point averages (GPAs; Advokat, Lane, & Luo, 2011; Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999; Meaux, Green, & Broussard, 2009), lower graduation rates (A. L. Green & Rabiner, 2012; Wolf, 2001), poorer self-reported quality of life (Blase et al., 2009), and higher rates of academic probation (Fan, McCandliss, Sommer, Raz, & Posner, 2002; Shifrin, Proctor, & Prevatt, 2010; Weyandt et al., 2013), which are relative to the general college population. ADHD symptomatology is present among college students in the United States in a pattern similar to that found in Chinese college students (Marsh, Norvilitis, Ingersoll, & Li, 2015; Norvilitis, Ingersoll, Zhang, & Jia, 2008).

The increased risk of anxiety, depression, daytime sleepiness, suicide, self-injurious behaviors, physical illness, decreased physical activity, risky sexual behavior, increased cigarette smoking, alcohol and drug dependency, and severity of work performance difficulties are very common

among students with ADHD in college (Baker, Prevatt, & Proctor, 2012; Glass & Flory, 2012; Goniou & Moreno, 2013; Huggins, Rooney, & Chronis-Tuscano, 2015; Langberg, Dvorsky, Becker, & Molitor, 2014; Langberg, Dvorsky, Kipperman, Molitor, & Eddy, 2015; Martino & Advokat, 2004; Meinzer, Hill, Pettit, & Nichols-Lopez, 2015; Mesman, 2015; Nelson & Gregg, 2012; Patros et al., 2013; Prevatt, Dehili, Taylor, & Marshall, 2015; Shifrin et al., 2010; Van Eck et al., 2015; Van Eck, Markle, Dattilo, & Flory, 2014). It is found that the discovery and intervention of ADHD during college can decrease the incidence, severity, and duration of future mental health problems, including major depressive disorder, anxiety disorders, and substance abuse (Nelson & Gregg, 2012; Prevatt et al., 2015; Rooney, Chronis-Tuscano, & Yoon, 2012). Effectively treating ADHD in college lessens attention problems, improves quality of life, reduces depression and anxiety, increases health and fitness behaviors, and positively improves academic performance (Eddy, Canu, Broman-Fulks, & Michael,

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2015; Farmer, Allsopp, & Ferron, 2015; Fleming, McMahon, Moran, Peterson, & Dreessen, 2015). However, there are very few clinical trials conducted on the meaningful impact of ADHD in college, it is imperative to perform some feasible evidence-based interventions (DuPaul et al., 2009; Fleming & McMahon, 2012), and also there is an insufficient quantity of research investigating the efficacy of contemporary interventions for college students with ADHD. The principal aim of this study was to fill these gaps in the literature by conducting a preliminary evaluation on the efficacy of mindfulness-based cognitive therapy (MBCT) for college students with ADHD.

Important research demonstrates the efficacy of psychosocial interventions for ADHD (Antshel, 2015; Antshel & Barkley, 2008; Sonuga-Barke et al., 2013). Problematically, however, there is a paucity of empirical support for psychotherapeutic interventions for college students with ADHD in university settings (DuPaul et al., 2009; Fleming & McMahon, 2012). Very few treatment researches have been investigated with this population, dialectical behavior therapy may be more effective than skill handouts conditions, and generally comparable in improving inattention, impulsivity, executive functioning, and quality of life (Fleming et al., 2015). Cognitive behavior therapy has showed pre-/post-treatment improvements in ADHD symptoms and attention performance for college students with ADHD (Anastopoulos & King, 2015; Eddy et al., 2015). Personal strengths program or strategy instruction may assist students in discerning and using their strengths to achieve their goals related to academic classes (Allsopp, Minskoff, & Bolt, 2005; Farmer et al., 2015). Although these studies provide positive support for treatments for ADHD among college students, there are some limitations obviously. First, the lack of a randomized treatment-control group and the small sample size do not provide the statistical power and limit the generalizability of these studies. Second, in many college counseling clinics, traditional longer term cognitive-behavioral therapy may not be choicest. Because of limited resources that are always compounded by budget reductions and constraints on allowable therapy sessions, and perhaps above all, increased student demands on the waiting lists, some effective short-term treatment in academic settings is imperative (Kitzrow, 2003). Third, only self-reported ADHD was involved in basic symptom assessment, with no consideration in the measure of coexistent problems (e.g., depression, anxiety) that affect the treatment.

In consideration of these limitations, it is definite to conclude that the result of cognitive-behavior therapy discovered in the general adult population may not extend to college students. For example, college students undergo a large number of specific stressors that are undefendable to ADHD, such as a lifestyle in the college campus, including moving away from home and accustoming to a

new environment, academic stressors, an unsteady social support system, economic stressors, risky sexual behavior, increased cigarette smoking, alcohol and drug dependency, and sleep disorder (Norvilitis, Sun, & Zhang, 2010; Weyandt & DuPaul, 2006). Second, with regard to self-identity development, relationships complexity, developing world-views during college, college students with ADHD employ fewer self-control or self-disciplinary behaviors, and increase self-doubt, social difficulties, anxiety, and depression (Norvilitis et al., 2010; Weyandt & DuPaul, 2006). Because of specific stresses and experiences of college students, effective psychological treatments in the general adult population might not extend well to college students (A. L. Green & Rabiner, 2012).

MBCT, which is the combination of cognitive-behavioral therapy and mindfulness, shows promise as an effective intervention for ADHD (Cassone, 2015; Haydicky, Shecter, Wiener, & Ducharme, 2015; Haydicky, Wiener, Badali, Milligan, & Ducharme, 2012; Janssen et al., 2015; Schoenberg et al., 2014; van de Weijer-Bergsma, Formsma, de Bruin, & Bogels, 2012; Zylowska et al., 2008). MBCT's developing strategies include sustained attention training, emotion control, somatic awareness, non-judgmental awareness, curiosity, and acceptance of the "here-and-now," distancing from a self-focused perspective, openness to present experience (Frank, Jennings, & Greenberg, 2013; Holzel et al., 2011; Krisanaprakornkit, Ngamjarus, Witoonchart, & Piyavhatkul, 2010; Mitchell, Zylowska, & Kollins, 2015; Smalley, Loo, Hale, Shrestha, & McGough, 2009). MBCT has exerted positive effects on attention, mood, self-regulation, executive function, behavior problems, and quality of life in treating ADHD (Bueno et al., 2015; Tang et al., 2007; van de Weijer-Bergsma et al., 2012). Although MBCT is predominantly administered over eight (3-h) weekly sessions, some data support abbreviated formats of the comprehensive MBCT protocol. For example, 5 days (Tang et al., 2007) and 6 weeks (Haydicky et al., 2015) MBCT interventions significantly reduced inattention, anxiety, depression, anger, fatigue, conduct problems, and peer relations problems.

On the current treatment outcome research for ADHD, there is ascending verifiable evidence for the efficacy of MBCT. However, MBCT has only been experimentally researched in group, rather than individualized, formats, the latter mode of therapy most commonly used in college counseling clinics (Eisenberg, Golberstein, & Hunt, 2009; Sharkin, 2012). Therefore, the main objective of this study was to conduct a fundamental investigation of abbreviated MBCT (individualized) in the context of a randomized controlled research design. With the aim of developing shortened behavior therapies that might viably be applied within college clinic settings, this randomized controlled trial examined the efficacy of an abbreviated (6-week) MBCT

Table 1. Demographic and Clinical Characteristics of participants ($N = 54$).

Characteristics	MBCT ($n = 28$)		WL ($n = 26$)	
	<i>n</i>	%	<i>n</i>	%
Sex				
Female	12	42.9	12	46.2
Male	16	57.1	14	53.8
University				
Public	20	70.6	20	75.0
Private	8	29.4	6	25.0
ADHD subtype				
Inattentive	24	93.3	22	84.6
Combined	2	6.7	4	15.4
Psychopharmacological medication				
Methylphenidate only	8	28.6	8	30.8
Amphetamine only	8	28.6	10	38.5
Methylphenidate and SSRI ^a	2	7.1	0	0.0
Amphetamine and SSRI ^b	0	0.0	2	7.6
SSRI only ^c	2	7.1	0	0.0
None	8	28.6	6	23.1
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (years)	20.21	1.03	20.38	1.02
WAIS-IV	10.14	2.27	10.38	2.48
CAARS-S				
Inattentive subscale	70.36	10.86	69.31	10.39
Hyperactivity/impulsivity subscale	73.64	9.80	72.77	10.25
ADHD index subscale	73.57	7.58	73.62	6.46

Note. MBCT = mindfulness-based cognitive therapy; WL = wait-list; SSRI = selective serotonin reuptake inhibitor; WAIS-IV = Wechsler Adult Intelligence Scale-IV; CAARS-S = Conners' Adult ADHD Self-Rating Scale.

^aCitalopram ($n = 1$).

^bFluoxetine ($n = 1$).

^cSertraline ($n = 1$).

relative to a wait-list (WL) control group for college students with ADHD. This was a preliminary study of an abbreviated MBCT that, relative to traditional MBCT, would be more feasibly applied in college mental health clinics. Primary study hypotheses were as follows:

Hypothesis 1: MBCT participants would demonstrate reductions in ADHD symptoms compared with WL participants at post-treatment and follow-up.

Hypothesis 2: MBCT participants would experience less anxiety and depression in relation to WL participants at post-treatment and follow-up, compared with their anxiety and depression at pretest.

Hypothesis 3: Compared with WL control group, MBCT participants would experience greater levels of mindfulness after intervention.

Hypothesis 4: MBCT participants would outperform on neuropsychological performance compared with WL participants at post-treatment and follow-up.

Hypothesis 5: Treatment gains for MBCT would be sustained at 3 months follow-up assessment.

Method

Sample

The study population consisted of 27 undergraduate students who met revised criteria for ADHD in adulthood (see below) and were seeking treatment. They were recruited from five universities in a large city in the south of China. Participants were randomly allocated to either MBCT condition or WL control group. Groups were balanced taking account of gender, age, ADHD subtypes, and medication status (see Table 1). According to the beginning and end of the academic quarter in which treatment was administered, and the end of the following academic quarter, participants were assessed before treatment, after treatment, and at 3 months follow-up by an interviewer who was blind to participant condition. All participants from this sample received and signed the informed consent form (ICF). Approval for the study was obtained from the local ethics committee.

Participants were required to be currently recruited undergraduate students between the ages of 19 and 24, and to meet

Diagnostic and Statistical Manual of Mental Disorders (5th ed.; *DSM-5*; American Psychiatric Association, 2013) criteria for ADHD in adulthood, including symptoms that were present prior to age 12 and functional impairment of five symptoms in multiple domains. Primary diagnoses of ADHD were confirmed by three psychiatrists. Exclusion criteria were as follows: major depressive episode, bipolar disorder, substance abuse/dependence within the last 6 months, active suicidality, history of psychotic disorder, and learning difficulties or other cognitive impairments. Participants receiving pharmacological medication for ADHD must have remained at a stable dose for 1 month prior to enrollment. Baseline variables by treatment condition are shown in Table 1.

MBCT Intervention

The MBCT course was adjusted from the protocol for depressive disorders (Segal, Teasdale, Williams, & Gemar, 2002), which consisted of eight weekly 2.5-hr sessions (Didonna, 2009). The MBCT intervention differed from the original Mindfulness-Based Stress Reduction program in length and duration. In this study, MBCT included six weekly sessions for 1 hr. In addition, this MBCT was applied to an individual in place of traditional group format. See Table 2 for the weekly content that guided each component of the intervention. Assignments guided by compact disks (CDs) were required on average for 30 min of self-practice per day, alongside workbooks incorporating psycho-educative sessions, which were specific to ADHD. Treatment sessions were conducted at an on-campus outpatient psychology clinic. The intervention was delivered by a group leader and co-leader who were psychiatrists specializing in ADHD with 8 years' experience as MBCT trainers. Intervention was supervised by a licensed psychologist with experience in assessment and treatment of college students with ADHD.

Control Group

A group of 26 participants with no psychotherapy or counseling were instructed pharmacological medication for our treatment and served as a WL control group. They fulfilled the same criteria and were assessed with the same methodology. And, they would be offered MBCT at the end of the study (i.e., patient preference).

Procedure

Participants randomly assigned to MBCT group and WL group were assessed at pre-treatment, post-treatment, and 3-month follow-up by an interviewer who was blind to participant condition. Figure 1 summarizes the flow of participants through the study.

Table 2. MBCT Intervention Main Content by Sessions.

Week	Session theme	Mindfulness content
1	<ul style="list-style-type: none"> • Introduction of treatment plan • sitting meditation instructions 	<ul style="list-style-type: none"> • Overview of ADHD and mindful awareness • Basic 5-min sitting meditation on mindfulness of the breath
2	<ul style="list-style-type: none"> • Difficulties in practicing meditation discussed 	<ul style="list-style-type: none"> • Explain difficulties, encourage to work with the difficulties • Take responsibility for their actions.
3	<ul style="list-style-type: none"> • Body sensation experiences • concentration training 	<ul style="list-style-type: none"> • Shifts of attention to different instruments • Evoked feelings, and imagery or thought associations. • Counting breath meditation • Mindful awareness of daily activities
4	<ul style="list-style-type: none"> • Mindful awareness of thoughts and emotions 	<ul style="list-style-type: none"> • Explore negative or critical thoughts • Establish mindful awareness during emotional responses • Using imagery mediation of an emotionally evoking event
5	<ul style="list-style-type: none"> • Open awareness of all present-moment experiences 	<ul style="list-style-type: none"> • Fostering meta-attention
6	<ul style="list-style-type: none"> • Review the mindful awareness concepts and practices • Continuous mindful awareness practice 	<ul style="list-style-type: none"> • "Speaking council" exercise • Comment about their experience

Note. MBCT = mindfulness-based cognitive therapy.

The study contained a series of scales. Some of them have been translated and back-translated in prior use studies. And there are other questionnaires that were translated into Chinese by a Chinese government-certified translator and back-translated into English by a bilingual with a doctoral degree in linguistics.

Clinical Measures

ADHD symptoms—Conners' Adult ADHD Self-Rating Scale (CAARS-5). The self-report version of the Conners' Adult ADHD Rating Scale (CAARS-S: SV; Conners, Erhardt, & Sparrow, 1999) is used to assess the extent to ADHD symptoms. This questionnaire consisting of 30 items, which are scored on a 4-point Likert-type scale (0 = *not at all*, 4 = *very much*), can be organized in three subdomains: Hyperactivity/Impulsivity, Inattention, and the ADHD index. The CAARS has appropriate psychometric properties including

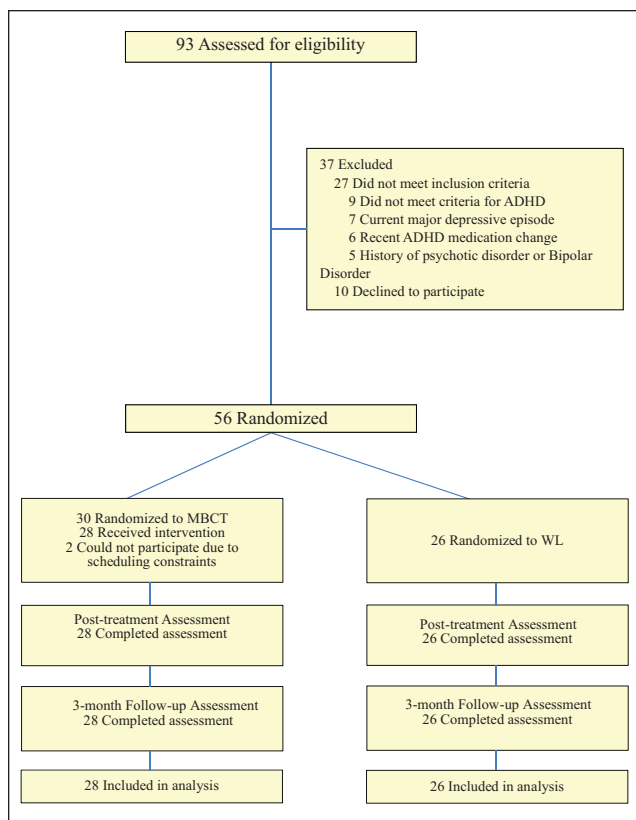


Figure 1. Flow of participants through the study.
Note. MBCT = mindfulness-based cognitive therapy; WL = wait-list.

internal consistency ranging from $\alpha = .76$ to $.95$ (Adler et al., 2008; Amador-Campos, Gomez-Benito, & Ramos-Quiroga, 2014). In this study, reliability was good ($\alpha = .92$).

Anxiety and depressive symptoms—Beck Anxiety Inventory (BAI) and Beck Depression Inventory–2nd edition (BDI-2). Because there are high rates of comorbidity between anxiety, depression, and ADHD in adults (Barkley, Murphy, & Fischer, 2010; Nelson & Gregg, 2012) and because anxiety and depression can affect the ability to pay attention, two self-report scales (Beck, Epstein, Brown, & Steer, 1988; Beck, Steer, & Brown, 1996) are used to assess anxiety and depressive symptoms in this clinical research. The scales consisting of 21 items have strong reliability and validity. Both calculate summed total scores that may be represented by level of impairment. In the present study, reliability was comparable for both scales (BAI $\alpha = .91$, BDI-2 $\alpha = .74$).

Academic performance. Before each assessment point, participants' GPA from the academic quarter was gathered via official transcript.

Mindfulness—Mindful Attention and Awareness Scale (MAAS). Participants' self-reported awareness was measured with the

MAAS (Brown & Ryan, 2003). The 15-item scale assesses the most important characteristics of mindfulness, a receptive and sensitive state of awareness in which attention of what is taking place in the present. Items are rated on a 6-point Likert-type scale (1 = *almost always*, 6 = *almost never*). An example item is "I could be experiencing some emotion and not be conscious of it until sometime later." The MAAS has good psychometric properties including test-retest reliability (intra class correlation = $.81$) and good internal consistency (α ranges from $.80$ to $.90$; Brown & Ryan, 2003; MacKillop & Anderson, 2007). In the present study, reliability was good ($\alpha = .90$).

Neuropsychological performance—Attentional Network Test (ANT; Fan et al., 2002). The computerized ANT (Fan et al., 2002), which tests the efficiency of the participants' attentional networks, was carried out at pre-treatment, post-treatment, and at 3-month follow-up. In the test, participants are instructed to focus on a fixation point on the computer screen. Each trial began with a warning cue (asterisks), which provides spatial and temporal information about the following target. The target stimulus is an arrow pointing either left or right at the center. The center arrow was flanked on either side by two arrows in the opposite direction (incongruent condition), or in the same direction (congruent condition), or by stripes (neutral condition). The participants' task was to point in the central arrow direction by pressing the right or left arrow key as fast and as accurately as possible when the target appears. There are four types of cue conditions. In the no-cue condition, the fixation cross remains on the screen during the cue presentation period, no cue appears, and the target is presented either above or below the cross. During the double-cue condition, asterisks simultaneously appear at target positions above and below the fixation cross, and the target is presented either above or below the cross. During the center-cue condition, a cue is presented at the same location as the fixation cross, and the target is presented either above or below the cross. During the spatial-cue condition, one cue is presented at the location of the target; the cue occurs in the same spatial location as the target position and the target is presented either above or below the cross. After initial practice trials, all participants performed a total of 96 experimental trials that lasted approximately 5 min.

Statistical Analysis

The two treatment groups were compared on baseline variables using independent samples *t* tests for continuous data. General linear models (GLMs) with repeated-measures ANOVA (RM ANOVA; Winer, Brown, & Michels, 1991) was performed to compare overall relative change in outcome variables between the two treatment conditions. The effect size statistic for this test is Cohen's *d*, where values

around 0.2 are considered small, values around 0.5 are considered medium, and values around 0.8 are considered large (S. B. Green & Salkind, 2014). Chi-square tests were used to conduct response analyses. The effect size reported for the overall model is partial η^2 . Statistical analyses were carried out using SPSS Version 19.0 for Windows.

Results

The intent-to-treat sample consisted of 30 and 26 participants from the MBCT treatment group and WL control group, respectively. Two participants dropped out of MBCT after six sessions and did not complete the post-treatment or follow-up assessments; all other participants completed treatment and the three study assessments. All analyses were performed without medication changes. There are no differences between two groups on any variable at baseline (all $ps > .05$). Baseline demographic information and primary clinical variables are summarized in Table 1.

Primary outcome data and results from the RM ANOVAs are displayed in Table 3, including within and between-groups mean change scores and effect sizes of mean change scores. Secondary outcome data and results from the RM ANOVAs are displayed in Table 4.

ADHD Symptoms

We hypothesized that MBCT participants would demonstrate reductions in ADHD symptoms compared with WL participants at post-treatment and follow-up. In intent-to-treat analyses ($N = 54$), participants who received MBCT showed an overall trend toward lower ADHD inattentive symptoms, $F(2, 52) = 9.380, p = .003$, partial $\eta^2 = .153$. MBCT showed significantly greater improvement than WL group on hyperactivity/impulsivity symptoms and the ADHD index. Among those responding to treatment, 16 (57%) showed positive response after MBCT, whereas six (23%) showed positive response after WL, $\chi^2(1) = 3.24, p = .07$. At follow-up, 20 (71%) MBCT participants showed recovery, compared with 8 (31%) WL participants, $\chi^2(1) = 4.46, p = .04$.

Anxiety/Depressive Symptoms and GPA

We predicted that MBCT participants would experience less anxiety and depression in relation to WL participants at post-treatment and follow-up, compared with their anxiety and depression at pretest. Results of the repeated-measures ANOVA for anxiety on the BDI indicated significant time effects, $F(2, 52) = 5.890, p = .019$, partial $\eta^2 = .102$. But there were no significant time effects on depressive symptoms, $F(2, 52) = 2.437, p = .125$, partial $\eta^2 = .045$, although participants who received MBCT did show significant change in depressive symptoms at post-treatment and

follow-up. Participants who received MBCT did not show significant change in GPA when compared with those in WL group, $F(2, 52) = 0.366, p = .548$, partial $\eta^2 = .007$.

Mindfulness

We hypothesized that MBCT participants would experience greater levels of mindfulness after intervention. Results of the repeated-measures ANOVA for Mindfulness indicated significant improvement on the MAAS at overall post-treatment and follow-up, $F(2, 52) = 9.965, p = .003$, partial $\eta^2 = .161$, versus those in WL group. Based on planned contrasts, MBCT outperformed WL both at post-treatment, $F(1, 52) = 11.831, p = .001, d = 1.06$, and at follow-up, $F(1, 52) = 10.862, p = .001, d = 1.30$.

Neuropsychological Performance

We hypothesized that MBCT participants would outperform on ANT compared with WL participants at post-treatment and follow-up. As shown in Table 4, participants who received MBCT showed a trend toward greater improvement on normalized reaction time (RT) and error score (ES) network data in the alerting network, versus those in WL group. MBCT also outperformed WL both on normalized RT and ES network data in the orienting network. But MBCT did not significantly outperform WL in the conflicting network on normalized RT network data, $F(2, 52) = 0.069, p = .793$, partial $\eta^2 = .001$, or ES network data, $F(2, 52) = 1.480, p = .229$, partial $\eta^2 = .028$.

Discussion

ADHD is significantly prevalent in college students (DuPaul et al., 2009; Weyandt & Dupaul, 2008, 2012) and associated with functional deficits related to decreases in attention, self-monitoring, and mood (Lewandowski et al., 2008). Nevertheless, in clinical trials of present psychological interventions, this population has been largely neglected. The primary objective of this study was to evaluate the efficacy of MBCT for college students with ADHD relative to a WL control group. This research shows randomized controlled trial of MBCT to date and also is the first assessment of abbreviated intervention among college students with ADHD. The treatment was designed especially for application in a college campus (i.e., simple, feasible, practical), and this intervention sample was demographically similar to college students at psychological clinic for services.

The major finding was that participants who received MBCT showed an overall trend toward lower ADHD inattentive symptoms, hyperactivity/impulsivity symptoms, and the ADHD index when compared with WL participants. MBCT participants outperform in ANT compared with WL participants at post-treatment and follow-up. MBCT

Table 3. Results of Primary Outcome Measures: Means, Standard Deviations, Mean Differences, and Effect Sizes (Cohen's *d*) by Treatment Group.

Outcome measure	Group	Pre-treatment			Post-treatment			Pre- vs. post-treatment			Pre-treatment vs. follow-up			Between-groups RM ANOVA		
		M (SD)		M (SD)	Mean differences ^a		M (SD)	Effect sizes ^{a,b}		Mean differences ^a		Effect sizes ^{a,c}		F	η^2	<i>p</i>
		WL	MBCT		Within group	vs. control		Within group	vs. control	Significance ^d	vs. control	Within group	vs. control			
CAARS Ina	MBCT	70.36 (10.86)	51.64 (8.39)	18.72	13.64	1.93	1.37	1.37	18.22	12.92	1.89	1.30	9.380	.153	.003	
	WL	69.31 (10.04)	64.23 (9.99)	5.08	5.08	0.51	0.53	0.53	64.01 (9.98)	5.30	0.53	0.75				
CAARS H/I	MBCT	73.64 (9.80)	60.86 (7.48)	12.78	11.16	1.47	1.20	1.20	14.43	15.66	1.60	1.42	9.059	.148	.004	
	WL	72.77 (10.25)	71.15 (9.63)	1.62	1.62	0.16	0.14	0.14	71.38 (9.04)	-0.23	0.14	0.75				
CAARS index	MBCT	73.57 (7.58)	60.71 (8.35)	12.86	11.01	1.61	1.26	1.26	12.07	10.6	1.38	1.26	11.174	.177	.002	
	WL	73.62 (6.46)	71.77 (9.17)	1.85	1.85	0.23	0.20	0.20	72.15 (8.44)	1.47	0.20	0.75				
BAI total	MBCT	14.00 (3.65)	9.50 (6.05)	4.50	5.35	0.90	0.88	0.88	4.36	4.21	0.89	0.75	5.890	.102	.019	
	WL	14.23 (4.60)	15.08 (6.63)	-0.85	-0.85	0.15	0.15	0.15	14.08 (6.01)	0.15	0.03	0.75				
BDI-2 total	MBCT	9.79 (4.57)	7.07 (2.71)	2.72	2.37	0.72	0.76	0.76	2.93	1.78	0.72	0.53	2.437	.045	.125	
	WL	9.77 (5.12)	9.42 (3.44)	0.35	0.35	0.08	0.07	0.07	8.62 (3.11)	1.15	0.27	0.32				
GPA	MBCT	2.64 (0.83)	2.71 (0.81)	-0.07	0.01	-0.09	0.07	0.07	0.14	0.29	0.08	0.32	0.366	.007	.548	
	WL	2.69 (0.71)	2.77 (0.71)	-0.08	-0.08	-0.11	0.07	0.07	2.84 (0.88)	-0.15	-0.19	0.32				

Note. RM ANOVA = repeated-measures ANOVA; CAARS Ina = Conners' Adult ADHD Self-Rating Scale, inattention symptoms; MBCT = mindfulness-based cognitive therapy; WL = wait-list; CAARS H/I = Conners' Adult ADHD Self-Rating Scale, hyperactivity/impulsivity symptoms; CAARS index = Conners' Adult ADHD Self-Rating Scale, ADHD index; BAI = Beck Anxiety Inventory; BDI-2 = Beck Depression Inventory-2nd edition; GPA = grade point average (college).

^aMean differences and effect sizes calculated, which represent improvement in all variables.

^bEffect sizes calculated with pooled standard deviation from pre-treatment and post-treatment.

^cEffect sizes calculated with pooled standard deviation from pre-treatment and follow-up.

^dSignificance value for post-treatment versus pre-treatment or follow-up versus post-treatment planned contrasts in within-groups RM ANOVA.

^eSignificance value for MBCT versus WL planned contrast in between-groups RM ANOVA.

p* < .05. *p* < .01. ****p* < .001.

Table 4. Results of Secondary Outcome Measures: Means, Standard Deviations, Mean Differences, and Effect Sizes (Cohen's *d*) by Treatment Group.

Outcome measure	Group	Pre- vs. post-treatment						Pre-treatment vs. follow-up						Between-groups RM ANOVA				
		Pre-treatment		Post-treatment		Mean differences ^a		Effect sizes ^{a,b}		Mean differences ^a		Effect sizes ^{b,c}		F	η^2	p		
		M (SD)	M (SD)	Within group	vs. control	Within group	vs. control	Significance ^d	vs. control	Within group	vs. control	Significance ^d	vs. control					
MAAS	MBCT	3.43 (0.74)	4.36 (0.83)	-0.93	-0.85	1.18	***	1.06	***	-1.07	-0.98	1.44	***	1.30	***	9.965	.161	.003
	WL	3.38 (0.85)	3.46 (0.86)	-0.08	0.09	0.09				-0.09	0.11	0.11						
ANT	MBCT	49.14 (4.44)	43.50 (5.51)	5.64	5.26	1.13	***	1.08	**	5.78	6.47	1.04	***	1.29	**	10.688	.170	.002
	WL	49.69 (5.19)	49.31 (5.21)	0.38	0.07	0.07				-0.69	-0.15	-0.15						
Alerting	MBCT	0.016 (0.011)	0.007 (0.005)	0.009	0.010	1.05	***	1.23	**	0.010	0.009	1.17	**	1.27	**	10.151	.163	.002
	WL	0.016 (0.009)	0.017 (0.010)	-0.001	-0.11	-0.11				0.001	0.11	0.11						
Orienting	MBCT	52.01 (5.68)	47.16 (5.59)	4.85	4.54	0.86	***	1.14	**	4.61	4.42	0.81	***	1.10	**	10.462	.167	.002
	WL	54.67 (7.30)	54.36 (7.07)	0.31	0.04	0.04				0.19	0.03	0.03						
Orienting	MBCT	0.036 (0.012)	0.024 (0.009)	0.012	0.011	1.13	***	1.02	**	0.013	0.014	1.18	**	1.13	**	9.558	.155	.003
	WL	0.036 (0.009)	0.035 (0.012)	0.001	0.09	0.09				-0.001	-0.09	-0.09						
Conflict	MBCT	100.71 (11.26)	99.29 (14.60)	1.42	0.42	0.11		0.02		3.00	2.30	0.25	**	0.19		0.069	.001	.793
	WL	100.62 (8.78)	99.62 (11.32)	1.00	1.00	1.00				0.70	0.07	0.07						
Conflict	MBCT	0.091 (0.011)	0.087 (0.015)	0.004	0.003	0.30		0.29		0.006	0.005	0.46		0.45		1.480	.028	.229
	WL	0.091 (0.009)	0.090 (0.008)	0.001	0.12	0.12				0.001	0.11	0.11						

Note. RM ANOVA = repeated-measures ANOVA; MAAS = Mindful Attention and Awareness Scale; MBCT = mindfulness-based cognitive therapy; WL = wait-list; ANT = Attentional Network Test; RT = reaction time (mean normalized); ES = error score (mean).

^aMean differences and effect sizes calculated, which represent improvement in all variables.

^bEffect sizes calculated with pooled standard deviation from pre-treatment and post-treatment.

^cEffect sizes calculated with pooled standard deviation from pre-treatment and follow-up.

^dSignificance value for post-treatment versus pre-treatment or follow-up versus post-treatment planned contrasts in within-groups RM ANOVA.

^eSignificance value for MBCT versus WL planned contrast in between-groups RM ANOVA.

*p < .05. **p < .01. ***p < .001.

participants showed a trend toward greater improvement on normalized RT and ES network data in the alerting and orienting network, versus those in WL group. This finding could be attributable to the MBCT treatment components focused on increasing present-focused non-judgmental awareness. Participants engage in mindfulness meditation, which can be defined as a form of mental training that can improve neuropsychological deficits in ADHD, such as attention control, by strengthening the function of brain regions believed to underlie these deficits (Tang, Holzel, & Posner, 2015). Mindfulness meditation could help reduce mind wandering and distractibility in ADHD by improving the functioning of the default mode network (a brain network that is active in the resting state and inactive during task performance), which causes impairments in executive functioning (Cortese et al., 2012), including in attentional processes such as sustained attention and set shifting, impulse control, and working memory (Bachmann, Lam, & Philipson, 2016). In this sample, MBCT participants experience less anxiety in relation to WL participants at post-treatment and follow-up, compared with their anxiety at pretest. MBCT may not require direct environmental exposure to anxiety provoking experiences and that are potentially aversive. Although there were no significant time effects on depression symptoms, participants who received MBCT did show significant change in depression symptoms at post-treatment and follow-up.

Even though study findings have high clinical significance, they are associated with some important limitations. First, the majority of the sample was Chinese students who were recruited through general psychology courses. Accordingly, these students may not be representative of the college student population on some important variables. Unfortunately, the sample size was too small for valid analyses even if study hypotheses were largely supported. Second, important potential outcome variables associated with ADHD in college students were not systematically assessed, such as poorer quality of life, self-injurious behaviors, increased cigarette smoking, alcohol and drug dependency, and severity of work performance difficulties. Third, future research with more heterogeneous samples is needed, both demographically and clinically. Co-existent anxiety and depression disorders were not systematically assessed, for example, the presence of which might affect the efficacy of the treatment. As a fourth limitation, it is probable that participants may not have reported information honestly. More precise reporting procedures might be used in future research. Finally, as this clinical study was not specifically designed to focus on mechanism of change factors, future research should address the impact of potential factors on treatment outcome, such as patient self-efficacy and therapeutic alliance.

Although there are some limitations, the abbreviated MBCT intervention was connected with mending participants' ADHD symptoms, mindfulness, and sustained

attention. While replication of these findings required, results show that abbreviated MBCT may be a helpful intervention for college students with ADHD. Most of positive findings supporting MBCT are based on that the intervention possibly gives a briefer and individually administered mindfulness treatment that might be more feasible in college clinics. And, these results also may have significant practical implications given that college counseling centers truly have a large amount of students with psychological needs featured with time restriction and a shortage of psychological counselors (Gallagher & Gill, 2004). Except for utilization with ADHD in college students, these time-efficient treatments may serve as practical and effective interventions for students at risk of experiencing functional deficits related to not listening and interrupting difficulties in social interactions. Considering these encouraging findings, it will be important for future studies to evaluate the relative efficacy and acceptability of psychosocial and psychopharmacological interventions for the treatment of ADHD among college students. In the future, randomized trials with greater statistical power are needed to fully measure mediators and moderators of treatment effect and assess therapist effects or non-specific factors of group psychotherapy.

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