A Randomized Trial of MBSR Versus Aerobic Exercise for Social Anxiety Disorder

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Objective: Effective treatments for social anxiety disorder (SAD) exist, but additional treatment options are needed for nonresponders as well as those who are either unable or unwilling to engage in traditional treatments. Mindfulness-based stress reduction (MBSR) is one nontraditional treatment that has demonstrated efficacy in treating other mood and anxiety disorders, and preliminary data suggest its efficacy in SAD as well. **Method:** Fifty-six adults (52% female; 41% Caucasian; age mean [*M*] ± standard deviation [*SD*]: 32.8 ± 8.4) with SAD were randomized to MBSR or an active comparison condition, aerobic exercise (AE). At baseline and post-intervention, participants completed measures of *clinical symptoms* (Liebowitz Social Anxiety Scale, Social Interaction Anxiety Scale, Beck Depression Inventory-II, and Perceived Stress Scale) and *subjective well-being* (Rosenberg Self-Esteem Scale, Satisfaction with Life Scale, Self-Compassion Scale, and UCLA-8 Loneliness Scale). At 3 months post-intervention, a subset of these measures was readministered. For clinical significance analyses, 48 healthy adults (52.1% female; 56.3% Caucasian; age [*M* ± *SD*]: 33.9 ± 9.8) were recruited. MBSR and AE participants were also compared with a separate untreated group of 29 adults (44.8% female; 48.3% Caucasian; age [*M* ± *SD*]: 32.3 ± 9.4) with generalized SAD who completed assessments over a comparable time period with no intervening treatment. **Results:** A 2 (Group) x 2 (Time) repeated measures analyses of variance (ANOVAs) on measures of clinical symptoms and well-being were conducted to examine pre-intervention to post-intervention and pre-intervention to 3-month follow-up. Both MBSR and AE were associated with reductions in social anxiety and depression and increases in subjective well-being, both immediately post-intervention and at 3 months post-intervention. When participants in the randomized controlled trial were compared with the untreated SAD group, participants in both interventions exhibited improvements on measures of clinical symptoms and well-being. **Conclusion:** Nontraditional interventions such as MBSR and AE merit further exploration as alternative or complementary treatments for SAD. © 2012 Wiley Periodicals, Inc. J. Clin. Psychol. 68:715–731, 2012.

Keywords: MBSR; aerobic exercise; well-being; social anxiety; social phobia; SAD; treatment outcome

Social anxiety disorder (SAD) is a highly prevalent (Kessler et al., 2005), chronic (Cairney et al., 2007), and undertreated (Wang et al., 2005) psychiatric condition. SAD is associated with self-criticism, low self-esteem (Cox, Fleet, & Stein, 2004), and an exaggerated focus on perceived deficient characteristics of the self (Goldin, Ramel, & Gross, 2009; Moscovitch, 2009). There

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are several empirically tested interventions for SAD, including pharmacotherapy and cognitive-behavioral therapy (CBT). These interventions are associated with decreased social anxiety symptoms and improved quality of life and well-being (see review by Pontoski, Heimberg, Turk, & Coles, 2010). Unfortunately, there are many individuals with SAD who are unwilling to undertake these treatments or who fail to adequately respond to them. This has prompted a search for nontraditional interventions, including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990).

Mindfulness-Based Stress Reduction

MBSR involves the cultivation of a nonjudgmental, flexible, and present-moment attentional focus (Kabat-Zinn, 1990) through a variety of practices that are thought to reduce the habitual tendency to automatically engage in and react to evaluative mental states (Segal, Williams, & Teasdale, 2002). In community samples of adults, MBSR has resulted in improved psychological well-being and mental health in a number of controlled and uncontrolled trials (e.g., Birnie, Speca, & Carlson, 2010; Cordon, Brown, & Gibson, 2009). MBSR has been embraced as a popular integrative medicine intervention (Hofmann, Sawyer, Witt, & Oh, 2010).

Preliminary data suggest that mindfulness practice may be a useful alternative to the current psychological treatments for anxiety disorders (Miller, Fletcher, & Kabat-Zinn, 1995) for those who do not want to participate in traditional treatments or those who are treatment nonresponders. Meta-analyses have supported the notion that MBSR reduces symptoms of stress, anxiety, and depression, and enhances well-being across clinical and nonclinical samples (e.g., Baer, 2003; Grossman, Niemann, Schmidt, & Walach, 2004).

Although some studies have examined MBSR's effects in mixed samples of patients with anxiety disorders (e.g., Vøllestad, Sivertsen, & Nielsen, 2011), few have targeted specific anxiety disorders (generalized anxiety disorder and panic disorder: e.g., Craigie, Rees, & Marsh, 2008; Evans et al., 2008; Kabat-Zinn, Massion, Kristeller, & Peterson, 1992; Kim et al., 2009; Lee et al., 2007), and fewer still have focused on SAD specifically (e.g., Bögels, Sijbers, & Voncken, 2006; Goldin & Gross, 2010; Goldin et al., 2009; Kocovski, Fleming, & Rector, 2009; Koszycki, Benger, Shlik, & Bradwejn, 2007). Mindfulness-based treatments for SAD have been shown to improve mood, functionality, and quality of life (Kocovski et al., 2009), reduce anxiety and depressive symptoms (Goldin & Gross, 2010), and increase self-esteem (Goldin & Gross, 2010; Goldin et al., 2009). Although in adults with SAD, MBSR has been shown to effectively reduce some anxiety symptoms and increase well-being, MBSR did not achieve the rate of response on core symptoms of SAD when compared with group CBT (with 8/18 in CBT and 2/22 in MBSR achieving full remission rates; Koszycki et al., 2007).

Aerobic Exercise

Physical exercise has been associated with a wide range of benefits, including improved physical health, mental health, and well-being (Penedo & Dahn, 2005). Psychologically, physical *inactivity* has been linked to increased symptoms of depression and anxiety (Ströhle, 2009) and decreased positive mood states (Penedo & Dahn, 2005). Several meta-analyses have observed a beneficial effect of exercise on anxiety (e.g., Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Stich, 1998). Research has demonstrated that high-intensity aerobic exercise (AE) is associated with lowered anxiety sensitivity (Broman-Fulks, Berman, Rabian, & Webster, 2004) and state and trait anxiety (e.g., McEntee & Halgin, 1999). Studies have noted the positive effects of exercise on panic disorder (e.g., Broocks et al., 1998; Dratcu, 2001) and generalized anxiety disorder (e.g., McEntee & Halgin, 1999; Steptoe, Edwards, Moses, & Mathews, 1989).

Smits and colleagues' (2008) study showed that even a 2-week exercise intervention and a 2-week exercise plus cognitive restructuring intervention were able to lead to clinically significant changes in anxiety sensitivity when compared with a waitlist condition. AE has been gaining momentum as an alternative to traditional treatments for a variety of anxiety disorders (see reviews by Herring, O'Connor, & Dishman, 2010; Salmon, 2001), and AE has been studied in samples of mixed anxiety disorders (e.g., Merom et al., 2007); however, these findings are not

clearly generalizable from one anxiety disorder to another (Ströhle, 2009). To date, there are no studies specifically examining the effects of AE in SAD.

The Present Study

To address this gap in the literature, we conducted a randomized controlled trial (RCT) of MBSR versus an active comparison condition, namely, AE in adults with SAD. Because AE has been shown to be beneficial across a range of symptoms and disorders and can include both individual and group components, it therefore seemed well-suited to be an active comparison condition that would allow us to match to nonspecific factors of MBSR while having the absence of active ingredients in MBSR. We expected that both MBSR and AE would lead to clinical improvement, but that compared with AE, MBSR would result in greater reduction in clinical symptoms and greater enhancement of well-being at both immediately post-intervention and at 3 months post-intervention. To address the possibility of spontaneous improvement or regression to the mean, we compared the effects of the RCT (MBSR and AE) with a separate, untreated group of similar individuals with SAD who were assessed before and after a period of no treatment. We expected that, compared with this separate untreated SAD group, the RCT interventions would result in both greater reduction of clinical symptoms and enhancement of well-being.

Methods

RCT Participants

Participants in this RCT were adults who met the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV; American Psychiatric Association, 1994) criteria for a principal diagnosis of generalized SAD. Diagnoses were made by clinical psychologists (PG & KW), who were trained (via training tapes and test cases) to administer the Anxiety Disorders Interview Schedule for DSM-IV-Lifetime version (ADIS-IV-L; Di Nardo, Brown, & Barlow, 1994). The ADIS-IV-L is a structured interview designed to assess for current and past (lifetime) diagnoses of anxiety disorders and permits differential diagnosis among the anxiety disorders according to DSM-IV criteria. In addition to anxiety disorders, the ADIS-IV-L assesses current mood, somatoform, substance use disorders, and medical and psychiatric treatment history, and includes screening questions for psychotic and conversion symptoms as well as familial psychiatric history. The ADIS-IV-L has demonstrated high reliability for a principal diagnosis of SAD (Brown, DiNardo, Lehman, & Campbell, 2001).

Seventy-seven potential participants met study inclusion criteria and were invited to participate. Twenty-one discontinued *prior* to randomization (16 failed to complete baseline assessments, two decided that SAD was not their primary problem, two were too depressed to participate, and one wanted psychotherapy). The remaining 56 participants were randomly assigned to either MBSR ($n = 31$) or AE ($n = 25$; Figure 1). Groups did not differ in gender, age, ethnicity, education, current or past Axis-I comorbidity, past psychotherapy, or past pharmacotherapy (see Table 1).

Nonrandomized Participants

Healthy controls. To conduct clinical significance analyses (see below), normative data for all relevant measures were also obtained from a separate sample of 48 healthy controls (52.1% female; 56.3% Caucasian; age mean [*M*] ± standard deviation [*SD*]: 33.9 ± 9.8) with no history of any psychiatric problems.

Untreated SAD participants. A separate, untreated group of 29 adults who met DSM-IV criteria for a principal diagnosis of generalized SAD based on the ADIS-IV-L was included. This group was part of a separate RCT (Goldin et al., 2011). When compared with RCT participants, the untreated SAD group did not differ in gender, age, ethnicity, education, current or past Axis-I comorbidity, past psychotherapy, or past pharmacotherapy (see Table 1). Potential participants

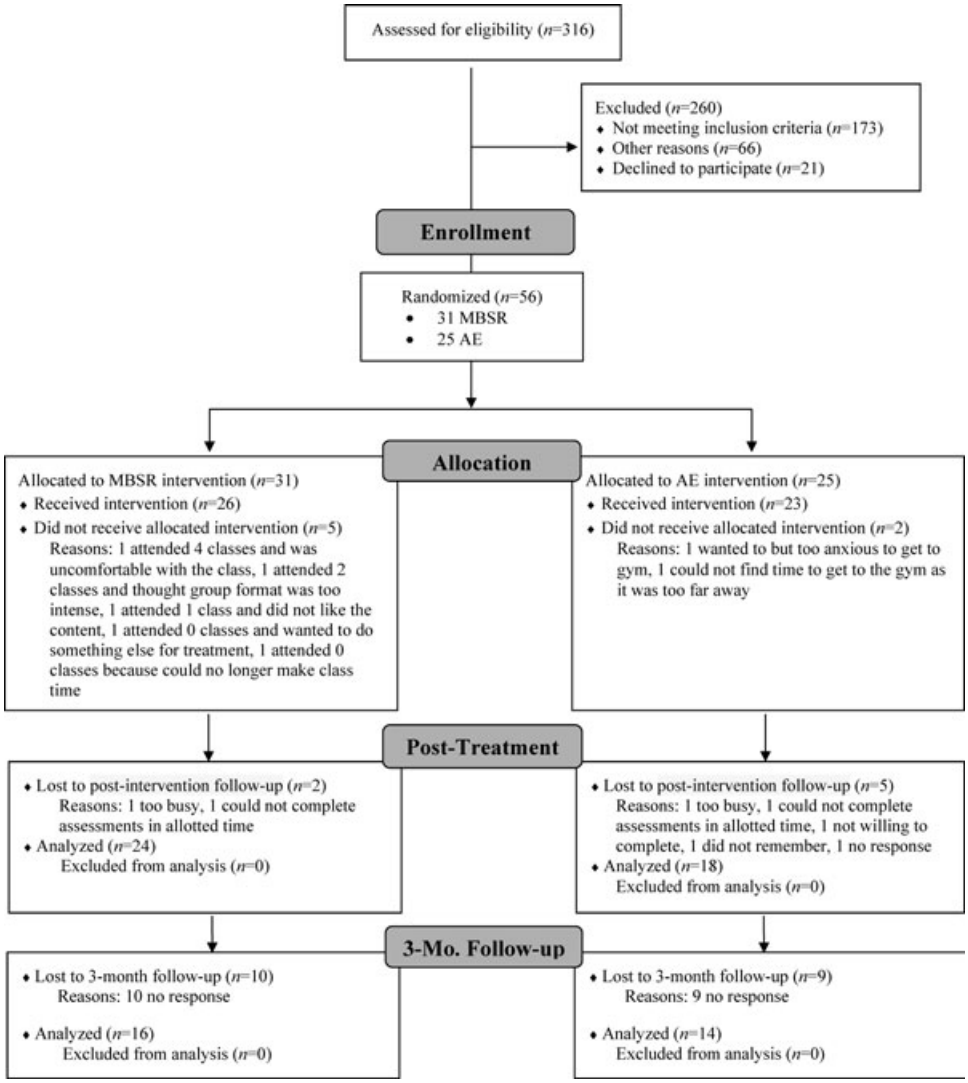

Figure 1. Consolidated standards of reporting trials diagram for randomized controlled trial of MBSR versus AE.

were excluded for current pharmacotherapy or psychotherapy, history of medical disorders or head trauma, and current psychiatric disorders other than SAD, generalized anxiety disorder, agoraphobia without a history of panic attacks, or specific phobia. The 29 individuals in this group were assessed at two time points (16 weeks apart) on the same measures as the RCT (MBSR and AE) groups.

Procedure

All participants were recruited through web-based community listings and referrals from mental health clinics and providers. Because this study was part of a larger neuroimaging study, participants were excluded for current pharmacotherapy or psychotherapy, history of medical disorders, or head trauma. Participants were also excluded for any current psychiatric disorders except principal diagnoses of SAD (operationalized as a score of $\geq$ 50 on the LSAS-SR, a score of 4 or more on the ADIS-IV-L Clinician's Severity Rating for SAD, and ratings of 4 or higher

Table 1
Demographic Characteristics for Individuals Randomized to MBSR or AE and UT SAD Participants

	MBSR $n = 31$	AE $n = 25$	UT $n = 29$	F or χ^2
Females, n (%)	19 (61.3%)	10 (40%)	13 (44.8%)	$\chi^2 = 2.88$
Age (*M* years ± SD)	32.87 ± 8.83	32.88 ± 7.97	32.34 ± 9.4	F = 0.04
Ethnicity, *n* (%)				$\chi^2 = 0.43$
Caucasian	13 (41.9%)	10 (40%)	14 (48.3%)	
Asian	14 (45.2%)	11 (44%)	9 (31%)	
Hispanic	3 (9.7%)	1 (4%)	1 (3.4%)	
Multiracial	1 (3.2%)	3 (12%)	5 (17.2%)	
Education (*M* years ± *SD*)	16.40 ± 2.00	16.84 ± 2.64	16.41 ± 1.76	F = 0.38
Current Axis-I Comorbidity				$\chi^2 = 4.88$
Generalized anxiety Disorder	10	8	6	
Major depressive disorder	5	6	0	
Dysthymia	2	3	2	
Specific phobia	3	2	1	
Panic disorder	2	2	0	
Agoraphobia	1	2	0	
Obsessive-compulsive disorder	1	0	0	
Past Axis-I Comorbidity				$\chi^2 = 1.49$
Major depressive disorder	9	2	5	
Dysthymia	1	0	1	
Panic Disorder	1	0	2	
Obsessive-compulsive disorder	0	1	0	
Substance abuse	0	1	1	
Eating disorder	3	1	1	
Past psychotherapy	15	9	11	$\chi^2 = 1.84$
Past pharmacotherapy	7	5	12	$\chi^2 = 1.56$

Note. MBSR = mindfulness-based stress reduction; AE = aerobic exercise; UT = untreated; SAD = social anxiety disorder; M = mean; SD = standard deviation.

for 5 or more specifically queried social/performance situations), generalized anxiety disorder, major depressive disorder, obsessive compulsive disorder, agoraphobia without a history of panic attacks, or specific phobia. Participants were excluded if they had previously completed an MBSR course, or if they had a regular meditation practice or exercise regime (regular was defined for our purposes as three or more times per week, for more than 2 months). An initial telephone screen and ADIS-IV-L were used to assess these inclusion criteria. Individuals with a principal diagnosis of generalized SAD were invited to participate in the study. Participants were randomized to 8 weeks of either MBSR or AE using the Efron's biased coin randomization procedure. This method removes potential confounds related to unequal assignment at different time points over a multiyear study. All participants provided informed consent in accordance with Stanford University Human Subjects Committee rules.

For all MBSR and AE participants, weekly phone calls were made to monitor practice and address any obstacles to meditation practice or AE. MBSR participants recorded weekly meditation practice (frequency and duration of formal and informal meditation practices), and AE participants recorded weekly exercise practice (frequency and duration of individual and group exercises). Participants completed measures of clinical symptoms and well-being (described below) pre-interventions and post-interventions, and at 3 months post-intervention a subset of these measures were readministered. Participants also completed the Kentucky Inventory of Mindfulness Scale (KIMS; Baer, Smith, & Allen, 2004) pre-interventions and post-intervention. The KIMS is a 39-item measure that examines four elements of mindfulness:

observing, describing, acting with awareness, and accepting without judgment. The instrument has good internal consistency and validity (Baer, Smith, & Allen, 2003).

Interventions

MBSR. We administered the standard MBSR program (Kabat-Zinn, 1990), which comprises eight, weekly 2.5 hour group classes, a 1-day meditation retreat, and daily home practice. Participants were trained in formal meditation practice (i.e., breath focus, body scan, open monitoring), brief informal practice, and Hatha yoga. Forms to monitor daily meditation and yoga practice were collected each week. Participants attended MBSR courses offered by seven different teachers in eight healthcare settings throughout the San Francisco Bay Area, which were unaware of participant's clinical status. The MBSR instructors had 15.7 years ($SD = 4.1$ years, range = 10 - 20 years) of MBSR teaching experience.

AE. We provided 2-month gym memberships to participants randomized to AE. Participants were asked to select a public health club or gym that they would be willing to attend for the duration of the study. To match the individual and group components of MSBR, participants in the AE intervention were required to complete at least two individual AE sessions (at moderate intensity) and one group AE session (other than meditation or yoga) each week during the 8-week intervention. Intensity of exercise and heart rate were not monitored. Guidance using gym equipment was not directly provided (though available through health club/gym personnel).

Assessment Measures

The following measures of clinical and well-being symptoms were administered at pre-intervention, post-intervention, and at 3 months following the intervention, except where noted.

The following sections describe the measures of clinical symptoms.

Liebowitz Social Anxiety Scale-Self-Report (LSAS-SR; Fresco et al., 2001). The 24-item LSAS-SR (which is highly correlated with the clinician-administered version; Baker, Heinrich, Kim, & Hoffman, 2002) includes questions pertaining to social interaction and performance situations. The LSAS-SR have shown to have good convergent, discriminant validity, and reliability (Fresco et al., 2001). Internal consistency as measured by Cronbach's alpha was good in all groups (MBSR = .90; AE = .90; healthy control [HC] = .92; untreated [UT] = .89).

Social Interaction Anxiety Scale Straightforward Scale (SIAS-S; Rodebaugh, Woods, & Heimberg, 2007). The SIAS-S is a 17-item measure of social anxiety in a variety of social interaction situations including dyads and groups. The SIAS-S has demonstrated strong internal consistency and construct validity (Rodebaugh et al., 2007). Internal consistency was adequate in the current samples (MBSR = .81; AE = .88; HC = .90; UT = .83).

Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is a 21-item assessment of depressive symptoms. The BDI-II has demonstrated high internal consistency in outpatient samples (Beck et al., 1996). Internal consistency was good in the current samples (MBSR = .94; AE = .91; HC = .84; UT = .94).

Perceived Stress Scale (PSS-4; Cohen, Kamarck, & Mermelstein, 1983). The PSS-4 is a 4-item brief version of the original PSS, the most widely used psychological instrument for measuring an individual's perceptions of stress during the past month. In non-SAD clinical samples, the PSS-4 has been shown to be internally consistent (Hewitt, Flett, & Mosher, 1992). In the present sample, internal consistency was good (MBSR = .88; AE = .78; HC = .64; UT = .81). This measure was not adminstered at the 3-month follow-up.

The following sections describe the measures of well-being and related constructs.

Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965). The RSES is a 10-item measure of self-esteem that includes five positive items and five negative items that are reversed scored. In general, the RSES has demonstrated good convergent validity and good test-retest reliability, and in similar populations of adults with SAD, the RSES has demonstrated high internal consistency (Kuo, Goldin, Werner, Heimberg, & Gross, 2011). Internal consistency was adequate in the present samples (MBSR = .89; AE = .86; HC = .79; UT = .87).

Satisfaction with Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985). The SWLS is a 5-item assessment of overall satisfaction with life as a whole, with higher scores indicating greater satisfaction with life. Questions are global rather than specific in nature. The SWLS has exhibited high internal consistency, test-retest reliability, and convergent and discriminant validity (Pavot & Diener, 2008). Internal consistency was adequate in the present samples (MBSR = .89; AE = .94; HC = .88; UT = .86).

Self-Compassion Scale (SCS; Neff, 2003). The SCS is a 26-item measure of self-compassion. The SCS has demonstrated strong convergent and discriminant validity, good test-retest reliability, and no correlation with social desirability (Neff, 2003; Neff, Rude, & Kirkpatrick, 2007). In a treatment seeking sample of adults with SAD, the SCS demonstrated excellent internal consistency (Werner et al., 2011). Internal consistency was good in current samples (MBSR = .88; AE = .87; HC = .93; UT = .90).

UCLA-8 Loneliness Scale (ULS-8; Hays & DiMatteo, 1987). The ULS-8 is the short version of the ULS (Russell, 1996), the most widely used measure of loneliness or social isolation. In general, the ULS-8 has strong reliability and validity (Russell, 1996). For present purposes, the scores were reversed so that lower scores indicated greater social integration. Internal consistency was adequate in the samples (MBSR = .74; AE = .80; HC = .83; UT = .83). This measure was not adminstered at the 3-month follow-up.

Statistical Analysis

Separate 2 (Group) x 2 (Time) repeated-measures analyses of variance (ANOVAs) on measures of clinical symptoms and well-being were conducted based on (a) treatment completers and (b) the intent-to-treat (ITT) sample. For the ITT analysis, we used a standard conservative method in which the participant's last observation was carried forward to account for missing data. Because the completer and ITT analyses yielded equivalent results, here we report only the completer analyses (results of the ITT analyses are available upon request).

We applied a modified Bonferroni correction to the measures in each domain to control for alpha inflation (Type I error). Significance was set at $p < .05/4 = .0125$. This correction is known to be conservative as it "over-corrects" the raw p values. Within-intervention effects were examined based on one-way repeated-measure ANOVAs. Partial eta-squared (η_p^2) was calculated to assess effect sizes (ESs) for between-treatment comparisons of post-intervention outcomes. ESs were also calculated for each treatment condition to evaluate the magnitude of pre-intervention to post-intervention change. Because there were no between-group differences at baseline on any measure (all ps $> .15$), no covariates were included in the analyses.

To assess the clinical significance of treatment-related changes, we used the methods described by Jacobson and colleagues (Jacobson, Roberts, Berns, & McGlinchey, 1999; Jacobson & Truax, 1991) to determine if treatment has moved a patient from the dysfunctional to functional range. Their method requires that two criteria be met. First, the Reliable Change Index (RCI) is used to determine whether the magnitude of change from baseline to post-treatment in each individual exceeds measurement error and is therefore a statistically reliable change. The formula for the RCI is as follows: 1.96 * baseline standard deviation * $\sqrt{2}$ * $\sqrt{(1 - \text{reliability})}$. For the reliability measure, we used the Cronbach's alpha computed from data in our own healthy control sample, which is preferable to published coefficient alpha values. Second, the baseline to post-treatment change must shift the individual into the range of a well-functioning group. To determine a cutoff score for establishing clinically significant change, we used Jacobson et al.'s (1999)

method C which determines whether an individual with SAD has moved to the healthy side of the halfway point between 2 SDs from the patient mean and 2 SDs from the healthy mean. Chi-squared analysis was conducted to determine whether the proportion of patients who had both statistically reliable change and clinically significant change differed following MBSR and AE. Meeting both criteria indicates that the patient had statistically reliable change and achieved normal functioning.

Results

Preliminary Analyses

Five of 31 (16%) participants dropped from MSBR, and 2 of 25 (8%) participants dropped during AE, a nonsignificant difference, χ^2 (1, $N = 56$) = 0.84, $p = .36$. Among treatment completers, 2 of 26 (7.7%) MBSR participants and 5 of 23 (21.7%) AE participants did not complete post-treatment assessments (Figure 1). The difference between groups in completion of post-treatment assessments was not significant, χ^2 (1, $N = 49$) = 1.97, $p = .16$. Among treatment completers, at 3 months post-intervention, 10 of 26 (38.5%) MBSR participants and 9 of 23 (39.1%) AE participants did not complete 3-month follow-up assessments. The difference between groups in completion of 3-month follow-up assessments was not significant, χ^2 (1, $N = 49$) = .40, $p = .53$. Between-group t tests showed that the average amount of time committed to practice each week in the MBSR ($M = 212$, $SD = 104$ minutes) and AE ($M = 196$, $SD = 86$ minutes) groups did not differ, $t(45) = 0.60$, $p > .55$. Analyses of scores on the KIMS revealed no differences between MBSR and AE at baseline, $t(53) = 0.09$, $p > .93$. We also detected no group by time effect ($F_{1,29} = 0.21$, $p > .65$, $\eta_p^2 = .01$): both interventions were associated with increased mindfulness ($KIMS_{MBSR} = F_{1,15} = 5.60$, $p < .03$, $\eta_p^2 = .27$ and $KIMS_{AE} = F_{1,12} = 5.13$, $p < .05$, $\eta_p^2 = .34$).

MBSR Versus AE

Baseline to post-intervention. Separate 2 Group (MBSR, AE) x 2 Time (pre, post) repeated-measures ANOVAs resulted in no significant interactions of group by time for clinical (all $ps > .16$) or well-being (all $ps > .33$) measures. There were also no main effects of group for clinical (all $ps > .11$) or well-being (all $ps > .28$) measures. However, there were main effects of time indicating improvement on clinical measures of social anxiety symptom severity (LSAS-SR: $F_{1,37} = 67.37$, $p < .001$, $\eta_p^2 = .64$; SIAS-S: $F_{1,32} = 36.45$, $p < .001$, $\eta_p^2 = .55$), depression (BDI-II: $F_{1,30} = 15.54$, $p < .001$, $\eta_p^2 = .33$), but not for perceived stress (PSS-4, $p > .06$). Main effects of time also were evident for well-being measures (RSES: $F_{1,30} = 17.11$, $p < .001$, $\eta_p^2 = .36$; SWLS: $F_{1,27} = 10.38$, $p < .01$, $\eta_p^2 = .29$; SCS: $F_{1,20} = 16.56$, $p < .001$, $\eta_p^2 = .44$; ULS-8: $F_{1,25} = 11.55$, $p < .01$, $\eta_p^2 = .30$; Figure 2).

Baseline to 3-month follow-up. Separate 2 Group (MBSR, AE) x 2 Time (pre-intervention, 3-month follow-up) repeated measures ANOVAs resulted in no significant interactions of group by time for clinical (all $ps > .17$) or well-being (all $ps > .17$) measures. There were also no main effects of group for social anxiety clinical measures (all $ps > .28$) or well-being measures (all $ps > .32$). However, there was a main effect of group for depressive clinical symptoms (BDI-II: $F_{1,25} = 7.50$, $p < .01$, $\eta_p^2 = .23$). Further, there were main effects of time indicating improvement on clinical measures of social anxiety symptom severity (LSAS-SR: $F_{1,28} = 62.79$, $p < .001$, $\eta_p^2 = .69$; SIAS-S: $F_{1,19} = 23.12$, $p < .001$, $\eta_p^2 = .55$), and depression (BDI-II: $F_{1,25} = 16.63$, $p < .001$, $\eta_p^2 = .40$; PSS-4 was not assessed at the 3-month follow-up). Main effects of time also were evident for well-being measures (RSES: $F_{1,22} = 9.06$, $p < .006$, $\eta_p^2 = .28$; SWLS: $F_{1,17} = 23.52$, $p < .001$, $\eta_p^2 = .57$; SCS: $F_{1,17} = 13.60$, $p < .002$, $\eta_p^2 = .43$; ULS was not assessed at the 3-month follow-up).

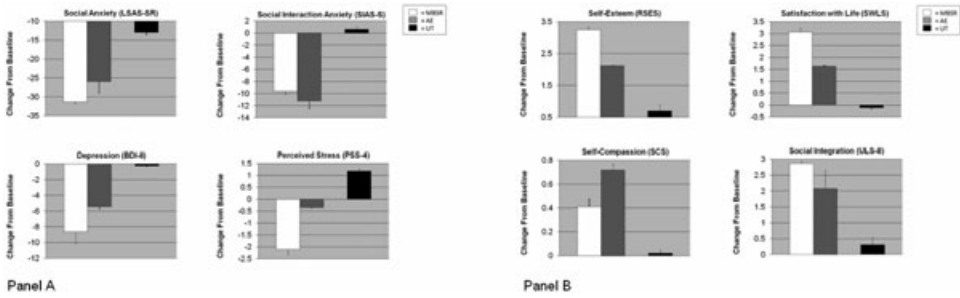

Figure 2. Panel A. Changes from pre-intervention to post-intervention on measures of clinical symptoms; Panel B. Changes from pre-intervention to post-intervention on well-being measures.
Note. MBSR = mindfulness-based stress reduction; AE = aerobic exercise; UT = untreated social anxiety disorder group; LSAS-SR = Liebowitz Social Anxiety Scale Self-Report; SIAS-S = Social Interaction Anxiety Scale Straightforward; BDI-II = Beck Depression Inventory-II; PSS-4 = Perceived Stress Scale 4-item; RSES = Rosenberg Self-Esteem Scale; SWLS = Satisfaction with Life Scale; SCS = Self-Compassion Scale; ULS-8 = UCLA Loneliness Scale inverse.

Clinical Significance

Clinical significance change RCI cutoff scores for clinical variables were derived as described above: LSAS-SR = 42.94, SIAS-S = 28.20, BDI-II = 4.47, and PSS-4 = 7.91. Based on these cutoffs, the percentage of participants meeting the threshold for clinical significance following MBSR and AE were as follows: 22.5% versus 29.5% for LSAS-SR, 25.2% versus 23.6% for SIAS-S, 53.1% versus 31.5% for BDI-II, and 36.4% versus 21.3% for PSS-4. Chi-squared analyses determined that the between-groups difference in clinical significance was not statistically significant on any of the clinical measures (χ^2: *p*s > .09). Cutoffs were also determined for well-being measures: RSES = 32.71, SWLS = 20.13, SCS = 2.9, ULS-8 = 18.54. The percentage of participants meeting the threshold for clinical significance following MBSR and AE was: 25% versus 6.3% for RSES, 20.1% versus 35.5% for SWLS, 35.5% versus 40.2% for SCS, and 6.7% versus 30.8% for ULS-8. Chi-squared analyses determined that the difference in clinical significance between the two groups was not statistically significant on any of the well-being measures (χ^2: *p*s > .1).

RCT Groups Versus Untreated Comparison Group

Separate 2 (Group) x 2 (Time) repeated-measures ANOVAs were used to test whether, compared with this separate untreated comparison group, MBSR and AE would result in significantly decreased clinical symptoms and increased well-being from pre-intervention to post-intervention (Figure 2). When MBSR was compared with the untreated SAD comparison group, there were interactions of group by time on nearly all clinical measures, revealing decreased symptoms of social anxiety, LSAS-SR: $t(44) = 4.52$, $p < .001$, $\eta_p^2 = .20$, SIAS-S: $t(44) = 3.02$, $p < .005$, $\eta_p^2 = .19$, and perceived stress, PSS-4: $t(27) = 2.92$, $p < .007$, $\eta_p^2 = .23$. After Bonferroni correction, change in depression was not significantly better for the MBSR group ($p \geq .03$). Results indicated greater improvement on two of the well-being measures in the MBSR group: satisfaction with life, SWLS: $t(28) = 2.72$, $p < .01$, $\eta_p^2 = .20$, and loneliness, ULS-8: $t(30) = 2.25$, $p < .03$, $\eta_p^2 = .14$. After Bonferroni correction, differences in self-compassion and self-esteem were not significant (all *p*s $\geq$ .03). When AE was compared with the untreated SAD comparison group, group by time interactions indicated decreased clinical symptoms for social anxiety, SIAS-S: $t(36) = 3.52$, $p < .001$, $\eta_p^2 = .25$, as well as improvement on self-compassion, SCS: $t(28) = 4.19$, and $p < .001$, $\eta_p^2 = .37$. The remaining clinical (all *p*s > .07) and well-being measures (all *p*s > .17) were not significant.

Table 2
Clinical Symptoms and Well-Being for Patients in the MBSR, AE, HC, and UT Groups

Measure	Group	Pre Mean (*SD*)	Post Mean (*SD*)	3-month follow-up Mean (*SD*)	Pre vs. Post F, *p*, effect size	Pre vs. 3-mo follow-up F, *p*, effect size
Clinical symptoms						
Liebowitz Social Anxiety Scale (Self-Report)	MBSR	86.82 (20.91)	55.50 (18.52)	55.56 (16.76)	**64.32, *.001*, .75**	**31.71, *.001*, .68**
	AE	87.38 (16.06)	61.41 (28.64)	54.86 (25.09)	**16.43, *.001*, .51**	**30.77, *.001*, .70**
	UT	78.37 (18.04)	65.42 (21.37)		**12.02, *.001*, .33**	
	HC	15.50 (11.30)				
Social Interaction Anxiety Scale (Straightforward Items)	MBSR	43.50 (9.85)	33.88 (7.66)	29.91	**10.27, *.006*, .41**	**13.82, *.004*, .58**
	AE	45.81 (9.05)	34.56 (14.10)	(7.38)	**19.18, *.002*, .49**	**10.36, *.01*, .54**
	UT	42.42 (10.19)	43.04 (12.57)	27.80 (14.83)	.11, *.75*, .01	
	HC	13.40 (8.60)				
Beck Depression Inventory-II	MBSR	13.94 (11.46)	5.29 (5.30)	4.73 (4.89)	**11.83, *.003* .43**	**6.94, *.02*, .33**
	AE	16.40 (7.84)	10.93 (8.88)	9.17 (6.77)	4.28, *.058*, .23	**9.53, *.01*, .46**
	UT	13.32 (10.25)	13.05 (10.60)		.01, *.92*, .01	
	HC	1.60 (2.80)				
Perceived Stress Scale	MBSR	10.00 (2.40)	7.90 (1.66)	–	**5.30, *.047*, .37**	–
	AE	10.17 (3.01)	9.83 (2.89)	–	.17, *.69*, .02	
	UT	9.43 (2.93)	10.62 (3.37)		3.40, *.08*, .15	–
	HC	6.50 (2.00)				
Well-being						
Rosenberg Self-Esteem Scale	MBSR	24.56 (3.46)	27.81 (3.82)	27.85	**15.18, *.001*, .50**	**6.95, *.02*, .37**
	AE	23.69 (4.60)	25.81 (4.59)	(5.15)	**4.48, *.05*, .23**	**3.34, *.01*, .23**
	UT	23.05 (5.52)	23.75 (6.44)	27.17	.80, *.38*, .04	
	HC	35.20 (3.80)		(4.76)		
Satisfaction With Life Scale	MBSR	14.00 (4.26)	17.07 (4.78)	17.27	**10.29, *.007*, .44**	**9.72, *.01*, .49**
	AE	14.00 (6.30)	15.64 (6.32)	(3.61)	2.37, *.15*, .15	**12.68, *.007*, .61**
	UT	15.33 (6.18)	15.22 (6.29)	16.11	.02, *.89*, .01	
	HC	21.80 (4.40)		(7.01)		
Self-Compassion Scale	MBSR	2.27 (.63)	2.68 (.45)	2.89 (.63)	1.70, *.23*, .20	4.37, .07, .38
	AE	2.10 (.46)	2.82 (.64)	2.97 (.67)	**22.71, *.001*, .64**	**10.46, *.008*, .49**
	UT	2.21 (.60)	2.23 (.72)		.02, *.89*, .01	
	HC	3.60 (.60)				

Table 2
Continued

Measure	Group	Pre Mean (*SD*)	Post Mean (*SD*)	3-month follow-up Mean (*SD*)	Pre vs. Post F, *p*, effect size	Pre vs. 3-mo follow-up F, *p*, effect size
Clinical symptoms						
UCLA Loneliness Scale	MBSR	25.07 (2.79)	22.20 (3.03)	–	**9.60, *.008*, .41**	–
	AE	24.85 (3.58)	22.77 (5.63)	–	2.99, *.11*, .20	–
	UT	23.68 (4.73)	23.37 (5.69)		.21, *.65*, .01	
	HC	12.70 (3.70)				

Note. MBSR = mindfulness-based stress reduction; AE = aerobic exercise; UT = untreated; HC = healthy control; SAD = social anxiety disorder; M = mean; SD = standard deviation.
Effect size = partial eta squared (η_p^2).

Discussion

The goal of this study was to examine the effects of a RCT of MBSR versus AE on clinical symptoms and well-being in adults with generalized SAD. Both MBSR and AE resulted in reductions of clinical symptoms and enhanced well-being both immediately post-intervention and at 3 months post-intervention. There were no statistically significant differences between the two interventions.

Why Was AE as Effective as MBSR?

One possible explanation for the surprising efficacy of AE is that as it was implemented in our study, AE involved physical AE and weekly attendance at the public gym with group classes. Aerobic exercise mimics many of the same bodily sensations elicited by anxiety reactions, such as increased heart rate, respiration, and perspiration (Broman-Fulks et al., 2004). It may be that AE led participants to evaluate their bodily responses differently (e.g., in a less threatening manner) than they had previously. In addition, repeated exposure to social stimuli at the gym may have resulted in habituation to social fear and changes in social cognitions (thus helping alleviate SAD symptoms). Many have argued that the efficacy of traditional treatments (such as CBT) can be attributed, at least in large part, to the exposure component (Rodebaugh, Holaway, & Heimberg, 2004). Further, others have alluded to exercise as a form of exposure in the context of other anxiety disorders (e.g., panic disorder; Marks, 1999). Additionally, the mere act of exercising (improving one's physical health) may assist in decreasing negative judgments and enhancing one's kindness towards oneself (self-compassion).

Comparing MBSR and AE to the Untreated SAD Group

When the RCT interventions (MBSR and AE) were compared with a separate, untreated, nonrandomized, comparison SAD group, MBSR was more efficacious on clinical measures of social anxiety and stress, and on multiple well-being measures including satisfaction with life and social integration (depression and self-esteem were no longer significant after the Bonferroni correction). When AE was compared with the separate, untreated, nonrandomized, comparison SAD group, AE was more efficacious on clinical measures of social anxiety and on the well-being measure of self-compassion. Because the MBSR, AE, and the untreated SAD group were not directly randomized as part of an RCT, strong inferences cannot be drawn; however, these results suggest that these interventions may be activating meaningful changes in clinical symptoms and well-being when compared with this untreated comparison SAD group.

Clinical Implications

Both MBSR and AE led to significant changes in clinical symptoms and well-being both immediately post-intervention and at 3 months post-intervention. Contrary to expectations, the magnitude of these effects was generally comparable for MBSR and AE. This research is important to continue exploring for several reasons. Individuals with SAD often underutilize mental health services (Magee, Eaton, Wittchen, McGonagle, & Kessler, 1996) and have a low rate of help-seeking behavior (Stein & Kean, 2000), possibly because of the stigma associated with psychotherapy and pharmacotherapy interventions, the fear of negative evaluation, or the financial burden involved with treatment (Olfson et al., 2000). Further, compared with traditional treatments for SAD, for some, MBSR and AE be more accessible, less costly, and less associated with stigma (Otto et al., 2007). Additionally, MBSR and AE may be important adjunctive interventions rather than standalone interventions for individuals who do not fully respond to traditional treatments; this possibility should be further explored.

Recent reviews have suggested that exercise may be an effective adjunct to clinical interventions (Stathopoulou, Powers, Berry, Smits, & Otto, 2006) and treatment manuals utilizing exercise for mood and anxiety disorders have been created (e.g., Smits & Otto, 2009). Acute AE has been associated with a reduction in state anxiety and an improvement in subjective well-being (Knapen

et al., 2009). Previous studies have shown that different forms of physical exercise in combination with standard anxiety treatments (e.g., group CBT) help reduce anxiety, depression, and stress symptoms (Merom et al., 2008). Additional studies that directly compare CBT to MBSR (e.g., Koszycki et al., 2007) as well as studies that determine whether there is an additive effect of MBSR or AE when combined with CBT are warranted.

Approximately a quarter of our participants demonstrated clinically significant change on social anxiety symptoms immediately following the interventions. While promising, this suggests that about three quarters of our participants did not achieve levels of social anxiety in the range of our nonanxious healthy controls. This is lower than what has been found in previous studies (ranges from 31%-75%) of individuals with SAD (e.g., Borge et al., 2008; Heimberg et al., 1990). One possible explanation is that the healthy control group utilized in this study is more "normal" than typical normal control groups. This is likely due to the stringent screening procedures and strict exclusion criteria from the healthy control group for (current or past) diagnoses that would typically be present in a meaningful percentage of the "normal" population. Nevertheless, the fact that such a large percentage of participants with SAD continued to experience clinically significant social anxiety symptoms after the interventions indicates that refinement and exploration of these alternative interventions for individuals with SAD is needed before these can be recommended as standalone interventions.

Limitations and Future Directions

This study of MBSR was the first to use AE as an active comparison intervention. One strength of this study was that separate from the direct RCT (MBSR and AE), it was possible to use an SAD untreated condition when examining the effects of these two interventions. In future studies, it will be important to *directly* randomize participants to a waitlist condition when examining these two interventions so that direct inferences can be made. Any apparent differences between groups may be due to the relative amount of group experience (i.e., time) entailed in each intervention. Having to face social fears related to being in a group setting and interacting with others in the MBSR intervention may have provided more opportunities to overcome social anxiety. Future research is needed to address whether these two interventions operate via different mechanisms as results may have important clinical implications.

Both interventions had acceptable dropout rates (AE = 8%, MBSR = 16%). The MBSR dropout rate is comparable to the 15.9% reported in Koszycki et al.'s (2007) study of SAD, and the AE dropout rate is comparable to the 11% reported in Martinsen et al.'s (1989) AE study of adults with anxiety disorders. On average, participants in both groups completed 3.4 hours of weekly practice. The amount of time spent practicing in MBSR and AE suggests that the two programs were well tolerated by participants. Future research may benefit from gathering explicit participant evaluation of the intervention and instructor. Further, adherence of MBSR instructors and treatment integrity must be kept to ensure efficacy. In addition to total number of minutes of AE per week, future studies should gather information on intensity and minutes per each exercise session. This information will allow for inferences regarding the effectiveness of AE as an intervention. Such information could be useful to test potential predictor or moderators of intervention effects.

In the present study, MBSR and AE led to meaningful changes in SAD. To better understand the mechanisms of change, future research should explore the mediators and moderators of MBSR and AE. Understanding the mechanisms responsible for AE-related and MBSR-related improvements will allow us to better understand why these unconventional interventions yield some unexpected clinically meaningful changes and help address treatment specificity. Future studies will benefit from including nonself-report measures including experimental tasks, daily experience sampling, biomarkers, and longer term assessment of training effects (beyond the 3-month period that was examined in this study).

This study required participants to voluntarily contact us to partake in the study (an exposure in itself), and all interventions were offered in outpatient settings. It is possible that participants in this study were less severe in their social anxiety symptoms and therefore may not be representative of more severe, treatment-seeking or clinically referred populations. In future studies, it

will be important to include a broader range of SAD symptom levels, as well as other psychiatric conditions so that results may be more generalizable.

Finally, this study examined two alternative interventions for adults with SAD. These interventions were well accepted and produced modest clinically significant changes, however not at the same level, as has been found in previous studies with traditional treatments (e.g., Heimberg et al., 1990). While it is possible that individuals in MBSR and AE spontaneously remitted to the same degree, the chronicity of SAD and the indirect evidence provided by comparison to the untreated SAD group suggest that future research should continue to explore alternative interventions such as MBSR and AE for SAD. Future research may benefit from examining the potential enhancement of treatment outcome with a combination of MBSR and AE, or the addition of MBSR or AE to traditional for treatments for SAD. Although traditional treatments are the preferred choice because of the empirical support for their efficacy, clinicians and researchers should continue to explore alternative methods that may assist in facilitating help-seeking behavior and reduce barriers to treatment access for individuals suffering from SAD.

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