

# Research

## Kundalini Yoga for Generalized Anxiety Disorder: An Exploration of Treatment Efficacy and Possible Mechanisms

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### Abstract

The aim of this study was to examine the efficacy of Kundalini Yoga in reducing symptoms of generalized anxiety disorder (GAD) compared to a common treatment-as-usual condition using cognitive techniques. A secondary objective was to explore potential treatment mechanisms. Females aged 24 to 75 years with GAD ( $n = 49$ ) received either an 8-week Kundalini Yoga intervention ( $n = 34$ ) or an 8-week treatment-as-usual condition ( $n = 15$ ). The yoga condition resulted in lower levels of anxiety relative to the treatment-as-usual condition. Furthermore, changes in somatic symptoms mediated treatment outcome for Kundalini Yoga. Kundalini Yoga may show promise as a treatment for GAD, and this treatment might convey its effect on symptom severity by reducing somatic symptoms. Gabriel, Curtiss, Hofmann, & Khalsa. *Int J Yoga Therapy* 2018(28). doi: 10.17761/2018-00003.

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### Introduction

Anxiety disorders are among the most common psychiatric disorders; a common form of anxiety is generalized anxiety disorder (GAD), with a lifetime prevalence rate of 5.2% in adults aged 18 to 64.<sup>1</sup> Given its deleterious effect on life functioning,<sup>2,3</sup> chronicity, and high comorbidity,<sup>4</sup> this condition is often treatment-refractory even with empirically supported treatments (e.g., cognitive behavioral therapy [CBT] and/or psychiatric medication).<sup>5</sup> Furthermore, considerable financial barriers, as well as limited treatment resources, inhibit individuals' access to first-line interventions.<sup>6</sup> To mitigate the societal and mental health burden imposed by GAD, complementary and integrative interven-

tions have been pursued. In particular, yoga-based treatments are promising in light of their accessibility, group format, increasing popularity,<sup>7</sup> and incorporation of mindfulness techniques, which have shown promise in treating anxiety disorders.<sup>8</sup>

Extant literature corroborates the efficacy of yoga in the treatment of emotional disorders.<sup>9-14</sup> It was demonstrated that yoga yielded improvement (82.5%) for symptoms of general anxiety and depression.<sup>15</sup> One study found that yoga techniques were more effective in relieving anxiety symptoms and in improving social adjustment than available drug therapy, and this pattern of results was replicated by other studies.<sup>16-18</sup> In another study, yoga-enhanced CBT was efficacious for individuals with GAD.<sup>19</sup> These results are consistent with research that has demonstrated that Sudarshan Kriya Yoga and Kripalu Yoga result in symptom reduction in individuals with GAD.<sup>20,21</sup> Indeed, reviews of the literature support the efficacy of yoga-based techniques in reducing stress, depression, and anxiety.<sup>11,14,22,23</sup> A recent meta-analysis of Hatha Yoga revealed that it is moderately efficacious (Hedges'  $g = 0.44$ ) in ameliorating symptoms of anxiety.<sup>24</sup> However, few trials were methodologically rigorous, attesting to the need for more controlled treatment-outcome studies to establish the efficacy of yoga.

A style of yoga with potential therapeutic benefit is Kundalini Yoga as taught by Yogi Bhajan, which emphasizes breathing techniques and meditation exercises in addition to the practice of physical postures and exercises and deep relaxation. Contemplative mind-body practices that foster the control of attention in the practice of meditation have been proposed for the treatment of GAD, as they may ameliorate worry by fostering mindfulness and decreasing physiological symptoms.<sup>8,25,26</sup> Increased mindfulness has been shown to exert an effect on cognitive activity by reducing self-referential thinking patterns and ruminative response styles.<sup>27,28</sup> Literature reviews and contemporary theories of

yoga demonstrate that it exerts an effect on autonomic functioning by increasing parasympathetic responses, which thereby reduces hyperarousal and excitation of cardiovascular systems.<sup>29–31</sup> Repeated yoga practice may facilitate parasympathetic control by altering the baseline reactivity threshold required to initiate a stress response.<sup>32</sup> Thus, reduction in somatic symptoms and autonomic arousal may be one of the primary biological mechanisms underlying the beneficial effects of yoga.

The purpose of the current study was to investigate the efficacy of an 8-week Kundalini Yoga program relative to a treatment-as-usual control consisting of individual psychotherapy using cognitive techniques designed to identify situations and modify maladaptive thinking patterns that result in emotional distress. In accordance with prior literature,<sup>10,11</sup> we hypothesized that Kundalini Yoga would yield greater reductions in anxiety and symptom severity than would the control condition. A secondary purpose of this study was to examine what mediates treatment improvement in Kundalini Yoga. Consistent with recent literature,<sup>25,31,33</sup> we hypothesized that decreases in somatic symptoms would mediate the treatment efficacy of Kundalini Yoga.

## Methods

### Participants

Participants ( $n = 49$ ) who satisfied the DSM-IV criteria for GAD were recruited from the surrounding communities of Windsor and Grafton, Vermont. Inclusion criteria required participants to be 18 years of age or older, English-speaking, medically stable, and to have a primary diagnosis of GAD. Subjects experiencing problems with substance abuse and/or dependence, psychosis, or suicidal and/or homicidal ideation were excluded from the study. All subjects who enrolled in the study were provided a credible treatment rationale for each of the treatment conditions. A retrospective review of the initial study protocol was conducted and approved by Solutions Institutional Review Board, LLC, in December 2013.

One of the lead authors (MGG) made diagnosis prior to treatment using an extensive unstructured interview. A paper-and-pencil survey exploring background history and prior treatment was also used to complete the intake process. The assigned diagnoses were consistent with the results of the self-report instruments.

### Procedure

Subjects met for 8 consecutive weeks for 1.25 hours in a group format in two separate groups. Author MGG, a licensed clinical social worker certified as a teacher in Kundalini Yoga, led the 8-week groups in both locations.

The treatment emphasized intensive training in yogic breath techniques, Kundalini Yoga *kriyas*, relaxation techniques, and specific yoga meditations incorporating control of attention/mindfulness, mantra, and breath regulation.

The format of the classes was consistent with the standardized instruction approach within the yoga tradition of Kundalini Yoga, in which all classes follow sequences of individual yoga exercises and techniques in the order in which they were originally taught by Yogi Bhajan. This style of yoga incorporates most of the postures and breathing techniques found in typical Hatha Yoga, although a variety of additional exercises and practices are unique to this style. Specific sequences of exercises and/or breathing meditations are called “kriyas” and all have ascribed targeted effects. This style of yoga strongly emphasizes integrating asanas with breath regulation, mantra, and meditation.

Each class opened with discussion regarding the experience of anxiety and stress and what yogic practices may help those suffering with GAD. After this discussion, the group class began with chanting of the opening mantra (the Adi Mantra: “Ong namo guru dev namo”) as is the Kundalini Yoga custom to help practitioners tune in to themselves. Participants then participated in specific guided breathing techniques (pranayama). After the breathing exercises, specific kriyas were practiced, followed by specific breathing meditation kriyas to foster relaxation, and then meditation. At the end of each class, participants were encouraged to practice the meditation and kriyas every day between classes. Written descriptions of all yoga practices were given to participants on a weekly basis to take home. Informal follow-ups during subsequent classes encouraged additional practice between classes. Limited feedback from participants suggested the recommended daily practice was not followed.

The control condition consisted of 8 weeks of 60-minute individual therapy, which entailed supportive listening and cognitive restructuring. This therapy approach is described elsewhere.<sup>34</sup> Using this specific cognitive rationale method, the control group individually explored recurring thinking patterns to identify and change inherent cognitive distortions for emotional relief. Strategies involved self-monitoring, cognitive restructuring, identifying thinking errors, and consciously developing alternative beliefs. Over the 8 weeks, the control group was given three handouts that reiterated concepts related to cognitive distortion patterns and suggestions related to formats for journaling. No specific homework assignments were given, but journaling was encouraged to identify distorted thought patterns and reframing.

Subjects participated in either condition based on patient preference. As discussed below, the nonrandomized control group with baseline differences and different modes

of treatment (individual vs. group) is a limitation of the study. However, including this control group still allowed us to explore treatment mediation within a quasiexperimental design.

At baseline and termination of treatment, subjects completed self-report measures. The main outcome measure (the Symptom Checklist 90–Revised [SCL-90-R]) was administered to all participants. Due to administrative issues, the control group did not receive the Beck Depression Inventory–II (BDI-II) and Beck Anxiety Inventory (BAI) measures. Furthermore, these two measures and the State-Trait Anxiety Inventory (STAI) were not administered to everyone in the Kundalini Yoga intervention. This occurred because these three instruments were administered after initiation of the study.

Every week, subjects were asked about whether they experienced any physical problems or other adverse events. Participants were given multiple ways to contact the instructor and encouraged to communicate any concerns or adverse events that should arise. Furthermore, during pre- and posttreatment assessments, participants were queried about adverse events and physical problems. No adverse events were reported.

### Measures

The SCL-90-R is a 90-item self-report symptom inventory to measure psychological symptoms and distress.<sup>35</sup> There are nine primary symptom dimensions and three summary scores termed global scores. The principal symptom dimensions are labeled Somatization, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. The global measures are referred to as the Global Severity Index (GSI), Positive Symptom Distress Index, and Positive Symptom Total. This instrument has good psychometric properties, with internal consistency coefficient alphas for the nine symptom dimensions ranging from 0.77 to 0.90.<sup>35</sup>

The STAI is a 40-item scale with a 4-point scale ranging from 1 to 4.<sup>36</sup> This self-report measure considers both the relatively stable individual differences in anxiety-proneness and discriminates it from state anxiety, the tendency to perceive stressful situations as dangerous or threatening right at the moment. Spielberger<sup>36</sup> reported high reliability on test-retest correlations as well as high internal consistency measures, with strong alpha coefficients ( $< 0.90$ ).

The BAI is a 21-item scale that assesses symptoms of anxiety.<sup>37</sup> Respondents rate how much they have been troubled by each symptom on a 4-point scale ranging from 0 to 3. The scale has good psychometric properties with high internal consistency and item-total correlations ranging from 0.30 to 0.70.<sup>37</sup>

The BDI-II is a 21-item scale with a 4-point scale ranging from 0 to 3.<sup>38</sup> This measure assesses primary symptoms of depression. The BDI-II has been found to have high reliability and validity with coefficient alpha ( $< 0.80$ ).<sup>38</sup>

### Data Analyses

Descriptive statistics (i.e., means and standard deviations [SD]), paired-sample *t* tests, and effect sizes were computed for all measures pre- and posttreatment across both conditions. To address the primary hypotheses of the current study, we conducted path analytic analyses to determine whether participants achieved greater symptom reduction in the yoga intervention relative to the control condition on measures of trait and state anxiety and symptom severity (i.e., STAI-T [trait], STAI-S [state], and SCL-90-R-GSI). The primary analyses controlled for pretreatment symptom severity, concomitant treatment, age, and prior yoga experience.

Mediation analyses were conducted using a nonparametric bootstrapping strategy.<sup>39</sup> Bootstrapping does not impose any assumptions about the shape of the sampling distribution of the indirect effect and therefore yields more accurate inferences. A significant indirect effect (*ab*) indicates mediation, and a nonsignificant direct effect (*c'*) of the independent variable on the dependent variable indicates full mediation. In accordance with recommendations for bootstrapping, the data were resampled 10,000 times.<sup>39</sup> Interpretation of significant indirect effects was facilitated by the evaluation of 95% confidence intervals (CI) for unstandardized regression coefficients such that intervals not containing 0 indicate significance.<sup>39,40</sup> Both the primary and mediation path analyses were conducted in R using the lavaan package.<sup>41</sup> Missing data were accommodated with full information maximum likelihood estimation.

Because of the quasiexperimental design of the current study, we determined whether there were baseline differences in clinical and demographic characteristics (i.e., GSI, STAI-T, STAI-S, age, and sex). To reduce bias caused by lack of randomization and baseline differences, the data were preprocessed using propensity score matching, a statistical procedure that attempts to emulate randomization by matching data from the treatment condition to data from the control condition.<sup>42</sup> By diminishing undue group differences, propensity score matching enhances causal interpretations of quasiexperimental studies. Propensity score matching analyses were conducted in R with the MatchIt package.<sup>43</sup>

## Results

### Demographic Characteristics

Of the 52 subjects who expressed interest in the intervention and were screened, 49 female participants were eligible

and self-assigned to a treatment condition (Kundalini Yoga = 34; treatment-as-usual control = 15). Three subjects were deemed ineligible. One attended the first class, did not like it, and therefore did not return. Another subject attended two classes but had to move outside the area for work. The third individual's work schedule changed and she was no longer available to attend the class on the night it was offered. Results are reported on all 49 females who completed the 8-week study. Mean age was 46 years (SD 14.73). All participants met criteria for GAD. Twenty-eight participants (57%) met criteria for both GAD and major depressive disorder.

Twenty-eight participants (57%) were on prescribed psychiatric medication and were stabilized on their dosage prior to participation in treatment. Furthermore, 31 participants (63%) were receiving psychotherapy, but were stabilized in treatment for more than 1 year and continued to experience clinical levels of anxiety symptoms. Fifteen of the participants in the yoga condition (44%) had never practiced yoga, and 19 participants (56%) endorsed past exposure to yoga. None of them had a regular ongoing yoga practice.

**Baseline Comparison**

Pairwise comparisons of the primary outcome measures revealed significant differences at baseline such that partici-

pants in the control group exhibited higher scores on the three primary outcome measures: STAI-T ( $t(42) = 2.50, p < 0.050$ ), STAI-S ( $t(42) = 2.34, p < 0.050$ ), and GSI ( $t(47) = 2.79, p < 0.001$ ). Moreover, individuals assigned to the yoga condition were older (mean 46.82 years, SD 14.61) than those assigned to the control condition (mean 39.27 years, SD 13.27) ( $t(47) = -2.12, p < 0.050$ ). Therefore, data were preprocessed using propensity score matching including clinical characteristics (i.e., baseline scores of the STAI-T, STAI-S, and GSI) and demographic characteristics (i.e., age) as covariates. The transformed data demonstrated a 98.73% reduction in the differences between the propensity scores of the two treatment conditions, which substantially mitigated pretreatment heterogeneity across conditions. Subsequent analyses controlled for baseline clinical characteristics, age, concomitant treatment, and prior yoga experience to determine whether treatment condition contributed a unique main effect. The control condition still facilitates experimental investigation of treatment mediation.

**Treatment Outcomes**

Means and SDs for all scales are reported in Table 1. No adverse events were reported. Across nearly all symptom measures, the yoga condition was associated with significant reductions from pre- to posttreatment and moderate to

**Table 1.** Mean Comparison of Pre- and Posttreatment Outcomes

Scale	Yoga Condition						Control Condition					
	<i>n</i>	Pre Mean	SD	Post Mean	SD	Effect Size	<i>n</i>	Pre Mean	SD	Post Mean	SD	Effect Size
SCL-90-R SOM	34	1.05	0.13	0.71**	0.65	0.38	15	1.30	0.81	1.33	0.84	0.04
SCL-90-R OBS	34	1.34	0.71	1.00**	0.68	0.49	15	1.73	0.66	1.95	0.87	0.26
SCL-90-R INT	34	1.32	0.92	0.94**	0.87	0.42	15	1.67	0.69	1.52	0.95	-0.17
SCL-90-R DEP	34	1.53	0.79	0.97**	0.74	0.73	15	2.10	0.61	2.00	1.01	-0.10
SCL-90-R ANX	34	0.98	0.48	0.67**	0.59	0.56	15	1.41	0.58	1.38	0.75	-0.04
SCL-90-R HOS	34	0.63	0.50	0.44*	0.35	0.44	15	1.42	1.03	1.30	0.99	-0.12
SCL-90-R PHOB	34	0.37	0.48	0.32	0.52	0.10	14	0.78	0.77	0.93	0.76	0.20
SCL-90-R PAR	34	0.84	0.62	0.60**	0.67	0.37	15	1.20	0.77	1.10	0.84	-0.12
SCL-90-R PSY	34	0.50	0.37	0.39	0.54	0.23	15	0.92	0.66	0.83	0.77	-0.12
SCL-90-R GSI	34	1.02	0.48	0.71**	0.54	0.60	15	1.46	0.54	1.46	0.71	0.00
SCL-90-R PSDI	34	1.82	0.41	1.51**	0.43	0.74	15	2.17	0.43	2.17	0.58	0.00
SCL-90-R PST	34	46.82	16.11	37.76**	21.79	0.45	15	57.67	12.62	56.60	20.30	-0.05
STAI Trait	29	46.28	11.99	40.53**	11.09	0.16	15	55.13	9.19	52.53	8.58	-0.29
STAI State	29	42.41	13.22	34.62**	12.27	0.91	15	51.67	10.71	50.27	10.95	-0.13
BAI	19	14.94	8.50	8.89**	7.55	0.75	0					
BDI-II	19	9.42	6.93	7.10**	7.59	0.41	0					

Note: Participants in the control condition did not complete the Beck Anxiety Inventory (BAI) or Beck Depression Inventory-II (BDI-II). No significant pre-post differences emerged in the control condition.

SD = standard deviation; SCL-90-R = Symptom Checklist 90-Revised (principal symptom dimensions = Somatization [SOM], Obsessive-Compulsive [OBS], Interpersonal Sensitivity [INT], Depression [DEP], Anxiety [ANX], Hostility [HOS], Phobic Anxiety [PHOB], Paranoid Ideation [PAR], Psychoticism [PSY]; global measures = Global Severity Index [GSI], Positive Symptom Distress Index [PSDI], Positive Symptom Total [PST]); STAI = State-Trait Anxiety Inventory.

\* $p < 0.050$ ; \*\* $p < 0.010$ .

**Table 2.** Path Coefficients of Primary Analyses

Outcome Variable	Predictors	$R^2$	Statistics		
			$B$	SE	$\beta$
Symptom Severity (GSI-Time 2)	Step 1:	0.75***			
	GSI-Time 1		1.07***	0.11	0.82
	Current treatment		0.17	0.12	0.12
	Age		0.00	0.00	0.00
	Prior yoga practice		-0.04	0.11	-0.03
	Step 2:	$\Delta$ 0.03*			
	GSI-Time 1		1.04***	0.11	0.79
	Current treatment		0.04	0.11	0.03
	Age		0.00	0.00	0.04
	Prior yoga practice Treatment condition		0.05 -0.31*	0.10 0.12	0.04 -0.21
Trait Anxiety (STAI-T-Time 2)	Step 1:	0.62***			
	STAI-T-Time 1		0.72***	0.11	0.70
	Current treatment		3.75	2.58	0.14
	Age		-0.05	0.08	-0.06
	Prior yoga practice		-1.87	2.29	-0.08
	Step 2:	$\Delta$ 0.03*			
	STAI-T-Time 1		0.69***	0.11	0.68
	Current treatment		1.21	2.81	0.05
	Age		0.00	0.08	0.00
	Prior yoga practice Treatment condition		-0.24 -5.57*	2.36 2.90	-0.01 -0.22
State Anxiety (STAI-S-Time 2)	Step 1:	0.46***			
	STAI-S-Time 2		0.63***	0.14	0.58
	Current treatment		4.48	3.53	0.15
	Age		-0.06	0.12	-0.06
	Prior yoga practice		-4.10	3.15	-0.15
	Step 2:	$\Delta$ 0.09*			
	STAI-S-Time 2		0.59***	0.13	0.54
	Current treatment		-0.67	3.68	-0.02
	Age		0.02	0.11	0.02
	Prior yoga practice Treatment condition		-0.79 -11.18**	3.10 3.85	-0.02 -0.38

*Note:* Displayed are the models of interest that accounted for a significant change in variance. Step 1 included relevant covariates, and step 2 included treatment condition.

GSI = Global Severity Index of Symptom Checklist 90–Revised; STAI = State-Trait Anxiety Inventory;  $\Delta$  = change;  $\beta$  = standardized beta coefficient.

\* $p < 0.050$ ; \*\* $p < 0.010$ ; \*\*\* $p < 0.001$ .

large effect sizes. No significant reductions in symptoms occurred in the control condition. Results of the primary analyses (Table 2) suggest that treatment condition contributed a main effect after controlling for relevant covariates (i.e., baseline symptoms, concomitant therapy, age, and prior yoga practice). Specifically, individuals assigned to the yoga intervention evidenced lower levels of anxiety and symptom severity at end-treatment than did those in the treatment-as-usual control. Furthermore, post hoc power analyses suggested that there was adequate power to detect a significant effect for most of the primary outcome variables: STAI-S (0.88), STAI-T (0.73), and SCL-90-R-GSI (0.82).

### Mediation Analyses

Path analyses were conducted to determine whether treatment condition exerted its effect on changes in anxiety and symptom severity by way of changes in somatic symptoms (Table 3). The results revealed that changes in somatic symptoms mediated the effect of treatment condition on changes in symptom severity ( $B = 0.17$ , standard error [SE] 0.02; 95% bias-corrected confidence interval [BC CI] = 0.04, 0.31). This indirect effect accounted for 42% of the variance in reductions of symptom severity. Furthermore, inclusion of the mediator variable attenuated the direct effect of treatment condition to nonsignificance, suggesting the presence of full mediation. No evidence was obtained

**Table 3.** Summary of Mediation Analysis Path Coefficients (and Standard Errors)

Independent Variable (IV)	Mediating Variable (M)	Dependent Variable (DV)	Effect of IV on M (a)	Effect of M on DV (b)	Direct Effect (c')	Indirect Effect (ab)	BC CI 95%
Treatment condition	Δ somatic symptoms	Δ symptom severity	0.39** (0.13)	0.44*** (0.10)	0.14 (0.09)	0.17 (0.06)	[0.04, 0.31]
Treatment condition	Δ somatic symptoms	Δ state anxiety	0.39** (0.13)	2.60 (4.14)	6.07 (3.75)	1.01 (1.62)	[-2.18, 4.20]
Treatment condition	Δ somatic symptoms	Δ trait anxiety	0.39** (0.13)	1.30 (2.99)	3.03 (2.73)	0.51 (1.17)	[-1.79, 2.80]

Note: Bolded confidence intervals represent significant indirect effects, as the intervals do not contain 0.

BC CI = bias-corrected confidence interval; Δ = change.

\*\* $p < 0.010$ ; \*\*\* $p < 0.001$ .

for an indirect effect of treatment condition on changes in anxiety symptoms. Furthermore, an alternative model was specified whereby reductions in anxiety symptoms mediated the effect of treatment on reductions in symptom severity; however, the indirect effect was not significant ( $\beta = 0.02$ , SE 0.02; 95% BC CI =  $-0.03, 0.06$ ).

## Discussion

The current study explored the efficacy of Kundalini Yoga compared to a treatment-as-usual control for individuals diagnosed with GAD. In accordance with our primary hypotheses, individuals receiving the Kundalini Yoga treatment evidenced greater symptom reduction than did those receiving treatment as usual. The differential efficacy of these two treatments was robust to potential confounds, as the effect of treatment condition was significant even after propensity score matching preprocessing and controlling for relevant covariates (i.e., baseline symptom severity, demographic characteristics, prior yoga experience, and concomitant treatment). Overall, this supports Kundalini Yoga as a potential treatment for individuals with GAD, which broadens the array of available empirically supported treatments for GAD.

A secondary purpose of this study was to identify potential treatment mechanisms of Kundalini Yoga. Consistent with our hypothesis, the results indicated that reductions in somatic symptoms mediated the treatment efficacy of Kundalini Yoga, which includes multiple exercises that target physical symptoms (i.e., distress from perceptions of bodily dysfunction focused on cardiovascular, gastrointestinal, respiratory, and other systems with strong autonomic mediation). Somatic symptom reduction as a mediator of Kundalini Yoga is consistent with prior literature.<sup>32</sup> One component underlying yoga is decentering (i.e., gaining distance from distressing thoughts and physical sensations). By fostering decentering, yoga allows an individual to uncouple somatic sensations from self-referential experiences. Cultivating decentering might convey a beneficial

effect on somatic symptoms, which would thereby contribute to the reduction of anxiety.<sup>32</sup>

It must be noted, however, that this indirect effect emerged only for symptom severity as the outcome variable. Perhaps this intervention leads to decreases in overall anxiety through other mechanisms, such as decentering. This would be consistent with literature suggesting that mindfulness-based interventions produce reductions in anxiety by way of changes in decentering.<sup>44</sup> Indeed, other studies also report an association between mindfulness and decreased levels of anxiety.<sup>27,45,46</sup> Furthermore, prior research has suggested that deficits in nonreactivity are a specific mechanism unique to worry symptoms of GAD.<sup>47</sup> This provides impetus for future research to further elucidate which treatment mechanisms affect which outcome variables.

Several limitations warrant mention. All study procedures, including recruitment, screening, intervention application, and outcome measures, were conducted by one of the lead authors (MGG), who is a proponent of Kundalini Yoga. Future studies should be conducted with blinded evaluation by independent research staff to avoid potential bias. Due to administrative issues, the control group did not receive the BDI-II and BAI instrument measures, and the STAI, BDI, and BAI were not administered to everyone in the Kundalini Yoga intervention. This occurred because these three instruments were administered after the study had already commenced. These different tests were given to complement the information provided by the main outcome measure (SCL-90-R), which was administered to all individuals. However, without having the BDI-II and BAI instruments in the control condition, it is not possible to determine whether the control treatment was properly administered in such a way as to effectively reduce anxiety and depression. Another limitation is related to noncompliance with home practice of yoga exercises. Although subjects were encouraged to practice even briefly (3 minutes) with kriya, meditation, or breathwork between classes, this was not uniformly done. No formal homework compliance assessment was conducted to identify reasons for

noncompliance, but it is common for novice practitioners of yoga to encounter difficulties in practicing exercises consistently. It may be of note that some participants mentioned they prioritized the breathing and meditation exercises during home practice because they perceived these as more helpful during periods of acute anxiety.

Although the current study used a controlled quasiexperimental design, formal randomization procedures were not applied, as treatment allocation was determined by patient preference. To address this, we employed propensity score matching procedures to mitigate systematic bias and corroborate causal interpretations of the quasiexperimental design. Another limitation related to the study design was the fact that participants selected which intervention they wanted to receive. Thus, conclusions about the relative efficacy of these treatments should be considered in light of potential self-selection biases. Exclusion criteria for the current study did not include concomitant treatment; however, this variable, as well as other confounding characteristics, was controlled for in the analyses, which revealed that treatment condition exhibited a unique effect on the treatment outcomes. Furthermore, future research should replicate the current pattern of results in studies with larger sample sizes; however, post hoc power analyses indicated sufficient power to detect significant effects for most of the primary treatment outcomes. It would be desirable to have included more frequent assessments of the primary outcomes and treatment mechanisms. This would have allowed for a more robust examination of mediation by better establishing temporal precedence. Moreover, it would be beneficial to investigate treatment mechanisms of Kundalini Yoga in other psychiatric disorders, as GAD is highly comorbid with various emotional disorders.<sup>48,49</sup> Notwithstanding the current limitations, the results are encouraging and suggest that larger and well-controlled studies examining Kundalini Yoga for GAD are warranted.

The effect sizes of the Kundalini Yoga intervention are comparable to those associated with CBT for anxiety. A comprehensive meta-analysis revealed moderate within-group effect sizes (Hedges'  $g = 0.51$ ) of CBT for GAD.<sup>50</sup> This is comparable to the within-group effect size of Kundalini Yoga for overall symptom severity ( $d = 0.60$ ). Furthermore, the efficacy of Kundalini Yoga in the current study is comparable to that of Hatha Yoga in a recent meta-analysis (Hedges'  $g = 0.44$ ).<sup>24</sup> The lack of within-group efficacy for the treatment-as-usual condition was surprising given that this treatment included cognitive restructuring, which is a core component of empirically supported CBT.<sup>50</sup> The lack of efficacy of this condition may be attributable to the fact that a substantial component of the 8-week treatment involved supportive listening to foster maintenance, and only a few active treatment elements of cognitive ther-

apy were introduced (e.g., identifying thinking traps). A more comprehensive version of CBT would comprise several other treatment components such as imaginal exposures, cognitive interventions targeting intolerance of uncertainty, and skills for challenging maladaptive metacognitions.<sup>5</sup> Another confounding issue related to the lack of within-group efficacy for this condition is the difference in treatment format across the two conditions (i.e., yoga in group format and treatment-as-usual in individual format). It may be the case that the collective support fostered in a group setting is a critical component of treatment efficacy. However, a recent meta-analysis has provided evidence that individual-format CBT for emotional disorders is more efficacious (Hedges'  $g = 0.54$ ) than group-format CBT (Hedges'  $g = 0.16$ ).<sup>51</sup> Future clinical trials of Kundalini Yoga should employ the same treatment format across groups to establish a more rigorous experimental design and to provide less ambiguous conclusions about the comparative efficacy of each treatment. Finally, it is important to note that the lack of efficacy of the control condition undermines the strength of having an active control condition, which limits the conclusions derived from the results. That is, future research on Kundalini Yoga would benefit from active control conditions to determine whether the treatment components specific to Kundalini Yoga are responsible for symptom reduction in comparison to another credible control treatment.

Collectively, the results of the current study indicate Kundalini Yoga shows promise as an alternative treatment for GAD, which may have implications from a public health perspective. The exorbitant cost associated with individual psychotherapy, as well as the limited availability of empirically supported treatments such as CBT, are among the barriers that hinder access to treatment.<sup>6</sup> The increasing prevalence of yoga in Western societies affords individuals with GAD more options for empirically supported treatment, which can mitigate the overall economic and mental health burden imposed by this condition.

### Disclosures

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M. G. Gabriel and Joshua Curtiss claim co–first authorship, as they contributed equally to the writing of this manuscript.

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