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Comparing Kundalini Yoga, cognitive behavioral therapy, and stress education for generalized anxiety disorder: Anxiety and depression symptom outcomes☆

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ABSTRACT

Increasingly, individuals with anxiety disorders are seeking mind-body interventions (e.g., yoga), but their effectiveness is unclear. This report summarizes seven additional, secondary outcomes measuring anxiety and depression symptoms from a study of 226 adults with generalized anxiety disorder who were randomized to 12-week Kundalini Yoga, Cognitive-Behavior Therapy (CBT) or stress education (control). At post-treatment, participants receiving CBT displayed significantly lower symptom severity, compared to those in the control group, on 6 of the 7 measures. Participants who received Yoga (vs. those in the control group) displayed lower symptom severity on 3 of the 7 measures. No significant differences were detected between participants receiving CBT vs those receiving Yoga. At the 6-month follow-up, participants from the CBT continued to display lower symptoms than the control group.

1. Introduction

Generalized anxiety disorder (GAD) is common, distressing, and impairing. Though pharmacotherapy and psychotherapy (e.g., cognitive behavioral therapy; CBT) are first-line treatments, many patients do not access them or respond. Mind-body interventions are increasingly popular. In our previously published primary clinical outcome paper, we reported findings for our 3-arm randomized controlled trial comparing group Kundalini Yoga, CBT, and stress education (control) for GAD. The findings at our primary endpoint (12 weeks of treatment) were that participants randomized to either CBT or Yoga showed higher treatment response rates (response defined as a Clinical Global Impression -Improvement rating of ``much improved'' or ``very much improved'') at post-treatment than participants in the control group. When we compared the two active treatments, we found that yoga was not significantly worse than CBT (for details please see Simon et al., 2021). At 6-month Follow-up, participants in CBT continued to have better response rates than participants in the control group, but participants in the Yoga group did not. To better understand the range of effects and to inform treatment decisions, this report examines secondary anxiety and depression outcomes from this trial. Examining both clinician-administered and self-report measures is important to improve the patient-centeredness of research, as self-report measures are thought to better reflect the patient perspective without bias related to clinician interpretation (Black et al., 2016).

☆ Trial Registration: clinicaltrials.gov identifier: NCT01912287

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2. Methods

Briefly, 226 adults (mean age = 33.4[13.5] years; 69.9% female) with a primary GAD diagnosis were randomized 2:2:1 to CBT(n = 90), Yoga(n = 93), or stress education (n = 43). All interventions were delivered in twelve weekly group sessions. The yoga intervention included postures, relaxation and breathing exercises, meditation, and yoga theory. CBT included psychoeducation, cognitive restructuring, progressive muscle relaxation, and exposure exercises. Stress Education included lectures in general health topics including effects of lifestyle factors on anxiety and stress (e.g., caffeine, alcohol, and smoking; resilience factors; exercise; diet). Detailed methods and primary outcomes are reported elsewhere (Hofmann et al., 2015; Simon et al., 2021). Data collection occurred between December 2013 and October 2019. The institutional review board at each site approved the study and all participants provided written informed consent.

Independent clinical evaluators rated the participants on the Hamilton Anxiety Scale (HAM-A) and the Clinical Global Impressions Scale-Severity (CGI-S). Self-report measures assessed anxiety (Beck Anxiety Inventory, BAI; State Trait Anxiety Inventory, STAI-S; and STAI-T), worry (Penn State Worry Questionnaire, PSWQ), and depression (Beck Depression Inventory-II, BDI). Self-reports were assessed at baseline, mid-treatment (week 6), post-treatment (week 12), and 6-month follow-up. HAM-A and Clinical Global Impressions-Severity were assessed every 2 weeks during treatment and at the 6-month follow-up.

Analyses used intent-to-treat multilevel growth curve models, including all participants regardless of missing data. The change over time in the outcome measures was not linear: Improvement was rapid at the beginning of treatment, but leveled off near the end of treatment (week 12). Thus, the growth curve for the outcomes during treatment was modeled as quadratic to reflect how improvement leveled off as treatment progressed. Because participants were treated in groups (3–6 participants per group), participant scores within each group might be related. Thus, our multilevel model accounted for this potential correlation by nesting participants within groups. Separate analyses were performed for each of the seven secondary measures of anxiety or depression (CGI-S, HAM-A, PSWQ, BAI, STAI-T, STAI-S, BDI; please see Table 1). Since the Type I error rate might be inflated because we performed 7 analyses, we report the raw p-value and whether each p-value was still significant after correcting for the False Discovery Rate, using the Benjamini-Hochberg correction. Covariates were site and baseline level of the outcome. Effect sizes were estimated using t-to-d conversion (small effect: $d = 0.20$; medium: $d = 0.50$; large: $d \geq 0.80$).

3. Results

Baseline sample characteristics (sex, race, ethnicity, education, or income) were not different between treatment groups (Simon et al., 2021), nor were treatment completion rates. Sixty-nine percent of the participants completed the post-treatment (week 12) assessment, and 61% completed the 6-month Follow-up. The percent of participants completing these assessments was not different between groups. See Table 1 for estimated intent-to-treat means and comparisons for each outcome.

3.1. Primary endpoint (Post-treatment)

Overall, participants in the active treatments (CBT, Yoga) displayed lower symptoms than the Stress Education control group at post-treatment. Specifically, compared to the Stress Education control group, participants in CBT reported significantly lower symptom severity on 6 of the 7 outcome measures, including the Penn State Worry Questionnaire, Beck Anxiety Inventory, State Trait Anxiety Inventory-State, State Trait Anxiety Inventory-Trait, Beck Depression Inventory, and the Clinical Global Impressions Scale-Severity (but not on the Hamilton Anxiety Scale). Similarly, Yoga participants reported lower symptom severity compared to Stress Education participants on 3 out of 7 measures: the Penn State Worry Questionnaire, State Trait Anxiety Inventory-State, and the State Trait Anxiety Inventory-Trait But Yoga participants did not differ from Stress Education participants on the Beck

Table 1
Means and Standard Deviations of Secondary Psychometric Outcomes by Treatment Over Time.

					CBT vs SE		Yoga vs SE		CBT vs Yoga	
		CBT	Yoga	Stress Education	Cohen's D	p-value	Cohen's D	p-value	Cohen's D	p-value
CGI-S	Baseline	4.7(0.7)	4.7(0.7)	4.6(0.8)						
	Post-treatment	3.1(1.1)*	3.3(1.1)	3.5(1.1)	.18	0.012*	0.09	NS	0.10	NS
	6-Mo Follow-Up	3.1(1.3)*	3.3(1.2)	3.4(1.1)	0.12	0.049	0.05	NS	0.09	NS
HAMA	Baseline	20.8(7.1)	20.9(6.3)	20.5(7)						
	Post-treatment	12.6(7.1)	12.4(6.5)	14.5(9.3)	0.11	NS	0.15	NS	−0.04	NS
	6-Mo Follow-Up	11.9(7.0)	13.4(7.5)	13.4(6.5)	0.04	NS	0.02	NS	0.07	NS
PSWQ	Baseline	64.3(12.7)	64.2(11.7)	64.2(10.4)						
	Post-treatment	41(17.1)*	45.8(19)*	52.0(17.5)	0.35	<0.001*	0.21	0.010*	0.16	0.048
	6-Mo Follow-Up	40.1(15.8)*	45.3(17.1)	51.4(16.4)	0.31	<0.001*	0.20	0.014	0.13	NS
BAI	Baseline	16.4(9.7)	16.4(8.9)	14.9(10.7)						
	Post-treatment	8.2(7)*	8.8(7.1)	11.5(10.7)	0.21	0.006*	0.14	NS	0.09	NS
	6-Mo Follow-Up	7.0(5.5)	7.3(5.5)	9.6(8.4)	0.14	NS	0.15	NS	−0.01	NS
STAI-S	Baseline	50.6(11.8)	50.3(10.9)	49.5(10.7)						
	Post-treatment	40.5(13.7)*	38.9(11.9)*	45.2(13.9)	0.24	0.003*	0.26	0.001*	−0.04	NS
	6-Mo Follow-Up	39.2(11.9)*	42.1(11.3)	43.4(11.6)	0.20	0.013*	0.07	NS	0.16	<0.041
STAI-T	Baseline	54.6(9.2)	54.5(8.5)	54.3(8.9)						
	Post-treatment	46.4(11.3)*	45.5(11.3)*	50.4(13.1)	0.30	<0.001*	0.29	<0.001*	0.01	NS
	6-Mo Follow-Up	45.2(10.9)	46.1(9.9)	46.3(10.0)	0.10	NS	0.07	NS	0.04	NS
BDI	Baseline	16.5(12)	14.4(8.6)	16.4(9.9)						
	Post-treatment	8.8(9)*	8.1(7.7)	12.1(12.6)	0.17	0.033*	0.15	NS	0.02	NS
	6-Mo Follow-Up	8.9(8.8)	7.8(8)	8.6(7.4)	0.00	NS	0.04	NS	−0.05	NS

Note: *Indicates group significantly differs after correction for multiple tests. NS = non-significant. 6-Mo Follow-Up = 6-month Follow-Up. CGI-S = Clinical Global Impressions Scale-Severity; HAM-A = Hamilton Anxiety Scale; PSWQ = Penn State Worry Questionnaire; BAI = Beck Anxiety Inventory; STAI-S = State Trait Anxiety Inventory-State; STAI-T = State Trait Anxiety Inventory-Trait; BDI = Beck Depression Inventory-II. CGI-S and HAM-A were clinician-administered, all others self-report. BDI measured depression, all others assessed anxiety or worry. P values are for pairwise comparisons at post-treatment or 6-month Follow-Up. Effect sizes were estimated using t-to-d conversions (small effect: $d = 0.20$; medium: $d = 0.50$; large: $d \geq 0.80$). A positive effect size indicates that the first treatment in the comparison listed at the top of the column had lower a better outcome than the second treatment. A negative effect size indicates that the first treatment had a worse outcome than the second treatment.

Anxiety Inventory, the Beck Depression Inventory, the Clinical Global Impressions Scale-Severity, or the Hamilton Anxiety Scale (Table 1). Only 1 symptom measure (Penn State Worry Questionnaire) was significantly lower for participants in CBT compared to the Yoga group, but this comparison did not survive correction for multiple tests.

3.2. Six-month follow-up

At the 6-month follow-up, participants in CBT showed significantly lower symptom severity than participants in Stress Education on the Penn State Worry Questionnaire, the State Trait Anxiety Inventory-State, and the Clinical Global Impressions-Severity. Analyses also suggested that participants in Yoga, compared to Stress Education, reported lower symptoms on the Penn State Worry Questionnaire, but this comparison did not survive correction for multiple tests. Similarly, analyses suggested significantly lower symptoms for participants in the CBT group versus the Yoga group on the State Trait Anxiety Inventory-State, but this comparison did not survive correction for multiple tests.

4. Discussion

Secondary anxiety measures were generally consistent with the primary outcome from this trial: Participants in CBT and Yoga both showed better post-treatment outcomes than Stress Education (control). Differences between outcomes in the CBT and stress education groups in worry, state anxiety, and Clinical Global Impressions-Severity were maintained at 6-month follow-up, aligning with a recent meta-analysis indicating long-term CBT efficacy for GAD (Van Dis et al., 2020). However, differences between outcomes in the Yoga and stress education (control) groups were not maintained at follow-up, consistent with a growing literature suggesting yoga is an effective short-term anxiety intervention with less clear long-term effects (Cramer et al., 2018). This may be due to the acute effects of yoga on affect and state anxiety that may not persist without ongoing practice (Szabo et al., 2017). Unfortunately, neither yoga nor CBT practice continuation were measured during follow-up in our trial. These secondary results support that both CBT and Kundalini Yoga are useful short-term treatments for anxiety. However, the overall pattern of results (including the longer-term results) support CBT as the first-line psychological treatment for GAD.

Of note, CBT but not Yoga ameliorated comorbid depression symptoms compared to Stress Education. Though CBT did not specifically target depression, skills learned (e.g., cognitive restructuring) may be generalizable, consistent with evidence that transdiagnostic interventions targeting anxiety and depression comorbidity are efficacious (Sakiris and Berle, 2019). Further, there is likely a dynamic, interconnected relationship between anxiety and depression, whereby reductions in anxiety may account for depression reduction over time (Bomyea et al., 2015).

It is unclear why self-reported anxiety reductions did not parallel the clinician-rated Hamilton Anxiety Scale, which is widely used in GAD treatment studies. It is possible the Hamilton's somatic-focus may have reduced ability to detect changes over time (Koerner et al., 2010). Other limitations include a predominantly White, highly-educated sample, which limits the generalizability of findings. Our results for Kundalini Yoga may also not fully generalize to other yoga types (e.g., other styles heavily focused on physical postures). Nonetheless, this study affirms the utility of CBT for GAD, and contributes to the growing literature suggesting that yoga is a viable option for short-term anxiety reduction for GAD. More research is needed to optimize long-term anxiolysis with yoga.

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Role of the funder/sponsor

The NCCIH representatives gave feedback on the design and conduct of the study before study initiation and used a study monitor during the study. The NCCIH played no role in the collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

CRediT authorship contribution statement

Elizabeth A. Hoge: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing, Project administration, Supervision. **Naomi M. Simon:** Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Kristin Szuhany:** Writing – original draft, Writing – review & editing. **Benjamin Feldman:** Writing – review & editing. **David Rosenfield:** Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing – review & editing, Funding acquisition. **Susanne Hoeppner:** Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing – review & editing. **Emma Jennings:** Writing – review & editing. **Sat Bir Khalsa:** Conceptualization, Writing – review & editing, Project administration, Investigation, Funding acquisition. **Stefan G. Hofmann:** Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

Dr **Hoge** reported receiving grants from the NIH during the conduct of the study.

Dr. **Simon** reports in past 3 years grants from American Foundation for Suicide Prevention, Department of Defense, PCORI, NIH, Cohen Veterans Network, and Ananda Scientific, consulting with Bionomics Limited, BehavR LLC, Vanda Pharmaceuticals Inc., Praxis Therapeutics, Cerevel, Genomind, Wiley (Deputy Editor Depression and Anxiety), Engrail Therapeutics Inc. Spousal equity from G1 Therapeutics and Zentalis, and royalty from Wolters Kluwer (UpToDate), APA Publishing (Textbook of Anxiety, Trauma and OCD Related Disorders 2020).

Drs **Szuhany** and Feldman, and Ms. Jennings, report no competing interests.

Dr **Khalsa** reports receiving grants from the NCCIH, NIH during the conduct of the study; receiving grants and personal fees from Kundalini Research Institute and grants from Kripalu Center for Yoga & Health outside the submitted work; and being a practitioner and certified instructor in Kundalini yoga as taught by Yogi Bhajan.

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Dr. **Rosenfield** reported receiving grants and personal fees from the NCCIH, NIH during the conduct of the study.

Dr. **Hoeppner** reported receiving grants from the NCCIH, NIH during the conduct of the study and receiving grants from the American Cancer Society, the Executive Committee on Research at MGH, Koa Health, and National Institute on Drug Abuse outside the submitted work.

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