Effectiveness of Yoga Therapy as a Complementary Treatment for Major Psychiatric Disorders: A Meta-Analysis

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Objective: To examine the efficacy of yoga therapy as a complementary treatment for psychiatric disorders such as schizophrenia, depression, anxiety, and posttraumatic stress disorder (PTSD).

Data Sources: Eligible trials were identified by a literature search of PubMed/MEDLINE, Cochrane Control Trials Register, Google Scholar, and EBSCO on the basis of criteria of acceptable quality and relevance. The search was performed using the following terms: *yoga for schizophrenia*, *yoga for depression, yoga for anxiety, yoga for PTSD, yoga therapy, yoga for psychiatric disorders, complementary treatment*, and *efficacy of yoga therapy.* Trials both unpublished and published with no limitation placed on year of publication were included; however, the oldest article included in the final meta-analysis was published in 2000.

Study Selection: All available randomized, controlled trials of yoga for the treatment of mental illness were reviewed, and 10 studies were eligible for inclusion. As very few randomized, controlled studies have examined yoga for mental illness, this meta-analysis includes studies with participants who were diagnosed with mental illness, as well as studies with participants who were not diagnosed with mental illness but reported symptoms of mental illness. Trials were excluded due to the following: (1) insufficient information, (2) inadequate statistical analysis, (3) yoga was not the central component of the intervention, (4) subjects were not diagnosed with or did not report experiencing symptoms of one of the psychiatric disorders of interest (ie, schizophrenia, depression, anxiety, and PTSD), (5) study was not reported in English, and (6) study did not include a control group.

Data Extraction: Data were extracted on participant diagnosis, inclusion criteria, treatment and control groups, duration of intervention, and results (pre-post mean and standard deviations, *t* values, and *f* values). Number, age, and sex ratio of participants were also obtained when available.

Data Synthesis: The combined analysis of all 10 studies provided a pooled effect size of -3.25 (95% CI, -5.36 to -1.14; P=.002), indicating that yoga-based interventions have a statistically significant effect as an adjunct treatment for major psychiatric disorders. Findings in support of alternative and complementary interventions may especially be an aid in the treatment of disorders for which current treatments are found to be inadequate or to carry severe liabilities.

Conclusions: As current psychopharmacologic interventions for severe mental illness are associated with increased risk of weight gain as well as other metabolic side effects that increase patients' risk for cardiovascular disease, yoga may be an effective, far less toxic adjunct treatment option for severe mental illness. *Prim Care Companion CNS Disord* 2011;13(4):doi:10.4088/PCC.10r01068 © Copyright 2011 Physicians Postgraduate Press, Inc.

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Psychopharmacology and psychotherapy are the primary treatment modalities utilized in Western psychiatry. Yet, the effectiveness of these therapies is limited. The well-accepted biopsychosocial approach for the treatment of mental illness has been expanded of late to include a spiritual component as well.^{1,2} Yoga can play a role in this comprehensive, holistic biopsychosocial-spiritual approach to healing mental illness.

In addition to limited effectiveness, psychopharmacologic interventions, particularly alone, are associated with side effects. Most notably, the antipsychotic medications used widely in the treatment of schizophrenia, bipolar illness, depression, and posttraumatic stress disorder (PTSD) are linked to metabolic side effects such as weight gain, diabetes, and dyslipidemias.³ The combination of these metabolic side effects, particularly obesity, with severe mental illness poses a major public health problem. In searching for ways to reverse antipsychotic medication–associated weight gain, we have identified yoga as an acceptable form of exercise as well as a plausible adjunctive therapy for the treatment of mental illness, particularly in the reduction of anxiety and depressive symptoms.

YOGA AS A COMPLEMENTARY TREATMENT

Yoga is an ancient Hindu practice that has only recently been documented by the Western world for its potential therapeutic effects. An increasing number of empirical studies have reported positive effects of mind-

CLINICAL POINTS

- Yoga can be effective in reducing symptoms of depression and anxiety.
- Yoga has few contraindications and few side effects.
- Yoga may be a helpful complementary treatment for psychiatric disorders.

body therapies for the treatment of mental disorders, such as depression and anxiety.⁴ The National Institutes of Health Center for Complementary and Alternative Medicine defines mind-body interventions as "a variety of techniques designed to enhance the mind's capacity to affect bodily function and symptoms."⁵ It is believed that yoga practice enhances the connection between the mind and body, and it is used as a therapeutic intervention in a variety of diseases. The mechanisms that allow for the potential therapeutic effects of yoga have been described as the modulation of the autonomic nervous system, especially a reduction in sympathetic tone, as well as activation of antagonistic neuromuscular systems and stimulation of the limbic system.⁶

There are many different schools of yoga that consist of different components such as physical yoga poses (*asanas*), controlled breathing (*pranayama*), meditation (*dhyana*), energy awakening, alignment, flexibility, chanting and singing, and word repetition.^{5,7,8} The studies included in our meta-analysis employed the forms of yoga used most commonly in the West: Hatha yoga, Iyengar yoga, Sudarshan Kriya yoga, and different types of meditative yoga.

Hatha yoga, the most popular form of yoga in the West, emphasizes the asanas, or physical yoga poses.⁹ Unlike most exercises, asanas are done slowly and are intended to encourage coordination between the body and the mind, to inspire relaxation and awareness, and to de-stress the mind.¹⁰ Iyengar yoga, a form of Hatha yoga created by B. K. S. Iyengar, focuses on the structural alignment of the physical body through the development of asanas and uses props such as belts and blocks as aids in performing the asanas.¹¹ Iyengar yoga has been developed so that it can be applied to various ailments, diseases, and disorders.¹²

Sudarshan Kriya yoga emphasizes slow and modulated breathing (*ujjayi*, *bhastrika*, and Sudarshan Kriya yogic breathing) thought to alleviate anxiety, depression, everyday stress, posttraumatic stress, and stress-related medical illnesses. The mechanisms in Sudarshan Kriya yoga thought to contribute to calmness include increased parasympathetic drive, calming of stress response systems, and the reduction of neuroendocrine release of hormones, such as cortisol.¹³

Meditation, a component of yoga employed by some studies included in our analysis, can be described as a conscious mental process that induces a set of integrated physiologic changes termed the relaxation response. Functional magnetic resonance imaging has been used to identify and characterize the brain regions that are active during meditation.¹⁰ Research suggests that during meditation, parts of the brain known to be involved in attention and in the control of the autonomic nervous system are activated, providing an anatomic and neurochemical basis for the effects of meditation on various physiologic activities.¹⁴ Meditation has been shown in 1 study to produce significant increases in leftsided anterior brain activity, which is associated with positive emotional states.⁵ Some studies have suggested that meditation can actually raise dopamine levels and exacerbate psychosis.^{15,16,17} However, these studies were not randomized, controlled trials, and, therefore, more research is needed to assess possible negative effects of meditation for individuals with mental illness.

Yoga is relatively safe and well tolerated with very few side effects when practiced correctly. Nevertheless, yoga therapy has not been established as an empirically based adjunct treatment to psychiatric disorders. The purpose of this meta-analysis was to examine the efficacy of yoga therapy as a complementary treatment among individuals with psychiatric disorders, such as schizophrenia, depression, anxiety, and PTSD.

METHOD

Selection of Studies

Eligible trials were identified by a literature search of PubMed/MEDLINE, Cochrane Control Trials Register, Google Scholar, and EBSCO on the basis of criteria of acceptable quality and relevance. The literature reference lists of retrieved trials, including reviews, were carefully examined to identify supplementary trials not registered or found during the literature searches. To avoid problems and limitations with the translation of reports, we decided to perform this meta-analysis solely on trials reported in English. Randomized, controlled trials both unpublished and published with no limitation placed on year of publication were included. The search was performed using the following terms: yoga for schizophrenia, yoga for depression, yoga for anxiety, yoga for PTSD, yoga therapy, yoga for psychiatric disorders, complementary treatment, and efficacy of yoga therapy.

Trials were excluded due to the following: (1) insufficient information, (2) inadequate statistical analysis, (3) yoga was not the central component of the intervention, (4) subjects were not diagnosed with or did not report experiencing symptoms of one of the psychiatric disorders of interest (ie, schizophrenia, depression, anxiety, and PTSD), (5) study was not reported in English, and (6) study did not include a control group. Studies with multiple interventions met inclusion criteria if the control group did not receive only the yoga-based intervention. Treatments other than yoga-based practices reported in the included studies were considered a control group for the purposes of this meta-analysis. All reported results were coded as a separate effect size for studies reporting more than a single result for several measures (ie, depression and anxiety). Only yoga therapy and control groups were analyzed from studies reporting a third intervention group along with the yoga-based intervention and control group. If multiple publication bias (same data reported in more than 1 publication) was identified, only data from 1 study were included.

Data Abstraction

Two researchers (P.C. and H.B.M.) extracted the data from the included studies. Data were extracted on participant diagnosis, inclusion criteria, treatment and control groups, duration of intervention, and results (pre-post mean and standard deviations, t values, and f values). Number, age, and sex ratio of participants were also obtained when available.

Statistical Analysis

Effect sizes based on standardized mean differences were calculated for each study. A random-effects model methodology was applied. The 2-tailed a level for statistical significance was set at P < .05. Ninety-five percent CIs were used to establish the precision of our results. Standard techniques of statistical calculations for meta-analysis and generation of plots were performed as incorporated in the software Comprehensive Meta-Analysis, V2.¹⁸ The homogeneity among studies was tested using the Cochran Q test; the level of significance was set at 0.1 due to the low power of the test to detect heterogeneity. We were unable to examine gender differences due to missing data. We were also unable to examine differences within each psychiatric disorder due to the lack of studies conducted for several of the disorders of interest (ie, schizophrenia and PTSD).

RESULTS

Study Characteristics

The literature search of databases and reference lists identified 38 potential trials. Of these 38 potential trials, a total of 10 trials representing 343 participants (186: yoga therapy and 157: control group [treatment other

than yoga-based practices]) who completed the trials were included in the analysis. Mean duration of the intervention was 7.7 weeks, with a minimum intervention of 2 weeks. Several different yoga interventions were used as treatment in the trials. These yoga interventions included Hatha yoga, Iyengar yoga, Sudarshan Kriya yoga, and a multitude of integrated or alternative forms of yoga and meditation, which were coded as "other." The most common yoga-based treatment used in the trials was Sudarshan Kriya yoga. The most common psychiatric disorders of participants in the trials were anxiety and depression, with only 1 trial examining PTSD and 1 trial examining schizophrenia. Although no limit was set on publication date, due to the novel interest in the subject, the oldest report was published in 2000. Characteristics of the included trials for meta-analysis are provided in Table 1.

Quantitative Data Synthesis

The Cochran *Q* test for homogeneity among studies was Q = 369.69 (P < .001) for fixed-model data. This result indicated heterogeneity among the studies, and a random-effects model was used. Exclusion sensitivity analysis showed that excluding single studies did not affect pooled results from the meta-analysis. The combined analysis of all 10 studies provided a pooled effect size of -3.25 (95% CI, -5.36 to -1.14; P = .002). Further details of the results are included in Table 2 and Figure 1.¹⁹

Publication Bias

Publication bias is a phenomena in which positive results have a better chance of being published, are published earlier, and are published in journals with higher impact factors. Conclusions exclusively based on published studies, therefore, can be misleading and consequently affect the implications of a metaanalysis. The funnel plot is a scatterplot of effect size against a measure of study size used primarily as a visual aid to detect and display publication bias. Large studies appear toward the top of the graph and tend to cluster near the mean effect size. Smaller studies appear toward the bottom of the graph and (since there is more sampling variation in effect size estimates in the smaller studies) will be dispersed across a range of values. In the absence of publication bias, we would expect the studies to be distributed symmetrically around the combined effect size.

By contrast, in the presence of bias, the bottom of the plot would show a higher concentration of studies on one side of the mean than the other. In other words, an asymmetric funnel indicates a relationship between treatment effect and study size. This would reflect the fact that smaller studies are more likely to be published if

Study	Psychiatric Disorder	Ν	Duration	Form of Yoga	Results
Janakiramaiah et al, 2000 ²⁴	Melancholic depression	45	4 wk	Sudarshan Kriya yoga	Participants in the yoga group, electroconvulsive therapy group, and imipramine group all demonstrated significant reductions of depression scores on the Beck Depression Inventory and Hamilton Depression Rating Scale; no significant effect of yoga on depression scores compared to the other groups
Duraiswamy et al, 2007 ²⁵	Schizophrenia	61	4 mo	Integrated yoga (other ^a)	Participants in the yoga group had significantly less psychopathology and significantly greater social and occupational functioning and quality of life compared to the control group (P <.01 for all measures)
Woolery et al, 2004 ²⁶	Depression and anxiety	28	5 wk	Iyengar yoga	Participants in the yoga group demonstrated significant decreases in self-reported symptoms of depression and trait anxiety compared to the control group (P <.01 for both measures)
van der Kolk, 2006 ²⁷	Posttraumatic stress disorder	11	8 sessions	Hatha yoga	Participants in the yoga group demonstrated significant decreases in frequency of intrusions ($P < .05$) and severity of hyperarousal symptoms ($P < .05$) compared to the group therapy group
Sharma et al, 2006 ²⁸	Depression	30	8 wk	Sahaj yoga meditation (otherª)	Participants in both the yoga and antidepressant group demonstrated significant improvements in neurocognitive functioning measures; participants in the yoga group demonstrated significant improvement in neurocognitive functioning on the digit span test compared to the antidepressant group (P <.05)
Butler et al, 2008 ²⁹	Depressive disorders	27	12 wk	Meditation with yoga and psychoeducation (other ^a)	Although all groups reported some reduction in symptom levels, they did not differ significantly in that outcome; yet, significantly more yoga group participants experienced a remission than did controls at 9-mo follow- up (P <.031)
Kozasa et al, 2008 ³⁰	Anxiety and depression	22	2 wk	Siddha Samadhi yoga (other ^a)	Participants in the yoga group demonstrated significant reduction in anxiety, depression, and tension scores, as well as significant increases in well-being scores compared to the control group (<i>P</i> <.05 for all measures)
Javnbakht et al, 2009 ³¹	Anxiety	65	2 mo	Integrated yoga (other ^a)	Participants in the yoga group demonstrated significant decreases in state ($P = .03$) and trait anxiety ($P < .001$) scores compared to the control group
Michalsen et al, 2005 ³²	Anxiety and depression	24	3 mo	Hatha yoga	Participants in the yoga group demonstrated significant improvement in perceived stress (P <.02), state and trait anxiety (P <.02 and P <.01, respectively), well-being (P <.01), vigor (P <.02), fatigue (P <.02), and depression (P <.05), as well as significant improvements in physical well-being (P <.01) compared to the control group
Vedamurthachar et al, 2006 ³³	Depression in alcohol dependence syndrome	60	2 wk	Sudarshan Kriya yoga	Participants in the control group demonstrated significant reduction in stress-hormone levels (cortisol and ACTH) (<i>P</i> =.005) along with Beck Depression Inventory score reductions (<i>P</i> =.003) compared to the control group

Table 1. Characteristics of the 10 Trials of Adjunctive Yoga Therapy Included in the Meta-Analysis

they have larger than average effects, which makes them more likely to meet the criterion for statistical significance.

The revision of the funnel plot revealed indications of publication bias (Figure 2). This was partly confirmed by a significant Egger regression test for publication bias (P=.007). Various statistical procedures were accessed to quantify and augment the publication bias (the classic failsafe N^{20,21} and Duval and Tweedie's trim and fill method²²). The classic fail-safe N asks if the entire observed effect is an artifact of bias. The trim and fill method offers a more nuanced perspective and asks how the effect size would shift if the apparent bias was to be removed.²³ If the meta-analysis had captured all of the relevant studies, then the funnel plot would be symmetric. That is, studies would be dispersed equally on either side of the overall effect. Therefore, if the funnel plot is actually asymmetric, with a relatively high number of small studies (representing a large effect size) falling toward the left of the mean effect and relatively few falling toward the right, then it may be that these right-hand studies actually exist and are missing from the analysis.

The trim and fill method allows for these studies to be imputed. That is, once it is determined where the missing studies are likely to fall, they are added to the analysis,

Table 2. Basic Statistics of Fixed and Random Models										
	Number of		Test of Null (2-tail)							
Model	Studies	Point Estimate	Standard Error	Variance	Lower Limit	Upper Limit	Ζ	Р		
Fixed	10	-0.414	0.155	0.024	-0.718	-0.110	-2.667	.008*		
Random	10	-3.252	1.075	1.156	-5.360	-1.145	-3.024	.002*		
* <i>P</i> <.05.										

Figure 1. Forest Plot of the 10 Studies Included in the Analysis^a



^aThe forest plot displays the measure of effect of each individual study, as well as the meta-analyzed measure of effect. The plot of measure of effect for each of these studies is represented by **■**, <, or >, with confidence intervals represented by horizontal lines. The overall meta-analyzed measure of effect is plotted as the diamond, the lateral points of which indicate confidence intervals for this estimate. The plot reveals that the included studies significantly favor yoga treatment over the treatments other than yoga-based practices.







and the combined effect is recomputed. The trim and fill method initially trims the asymmetric studies from the left-hand side to locate the unbiased effect, and then fills the plot by reinserting the trimmed studies on the left as well as their imputed counterparts to the right of the mean effect. The method looks for missing studies based on a random-effects model and looks for missing studies only to the right side of the mean effect (as the parameters are set by the researcher). Using these parameters, the method suggests that no studies are missing. Under the random-effects model, the point estimate and 95% CI for the combined studies was 0.00274 (0.00006–0.12542). These values were unchanged using the trim and fill method. Under a fixed-effects model, the trim and fill method suggests that 4 studies were missing (Table 3 and Figure 3). Under the fixed-effects model, the point estimate and 95% CI for the combined studies was 0.47184 (0.27170– 0.81740). The imputed point estimate was 1.20863 (0.02083–70.12864) using the trim and fill model.

Table 3. Results of Duval and Tweedie's Trim and Fill Method							
Variable	Value	Studies Trimmed	Point Estimate	Lower Limit	Upper Limit		
Random effects	Observed		0.47184	0.27170	0.81940		
	Adjusted	0	0.47184	0.27170	0.81940		
Fixed effects	Observed		0.47184	0.27170	0.81940		
	Adjusted	4	2.49114	1.48253	4.18595		





^aThe trim and fill method asks how the effect would shift if there were no publication bias by allowing us to impute missing studies. Using the random-effects model, no studies are missing. However, under a fixed-effects model, the trim and fill method displays 4 missing studies to the right of the mean. This funnel plot, a representation of the fixed-effects model, includes both observed studies and the 4 imputed studies by the black dots as well as the shift in the effect size.

One concern with regard to publication bias was that some nonsignificant studies were missing from the analysis and that these studies, if included, would nullify the observed effect. Therefore, rather than simply speculating about the impact of the missing studies, we computed the number of studies that would be required to nullify the effect. If this number was relatively small, then there was indeed cause for concern; however, if this number was large, we could be confident that the treatment effect, while possibly inflated by the exclusion of some studies, was not nil. This fail-safe N analysis is a reference to the number of missing studies that would nullify the effect.

This meta-analysis incorporated data from 10 studies, which yielded a Z value of -9.23159 and a corresponding 2-tailed P value of .00000. The fail-safe N was 212. This means that we would need to locate and include 212 null studies in order for the combined 2-tailed P value to exceed .050. Put another way, there would need to be 21.2 missing studies for every observed study for the effect to be nullified.

DISCUSSION

Results from the meta-analysis demonstrated that yoga therapy is an effective adjunct treatment for several psychiatric disorders (ie, depression, anxiety, PTSD, and schizophrenia), with a pooled mean effect size of -3.25 (95% CI, -5.36 to -1.14; P=.002). Yoga-

based practices may provide relief for symptoms left untreated through common treatments such as psychopharmacology and psychotherapy. Yoga breathing is probably one of the most important components that can be useful in the treatment of anxiety and PTSD. Yoga breathing (*pranayama*) requires a person to inhale deeply through the nose into the lungs. This alone is a very calming, mindful activity that can decrease stress.

There were some signs of heterogeneity and publication bias among the trials, but exclusion sensitivity analysis did not indicate that one specific trial had a major impact on the pooled effect estimate. In addition, an analysis of the fail-safe N revealed that we would need to locate and include 212 null studies in order to nullify the effect found. If this number had been relatively small, then there would be cause for concern. However, this number is large, and we can thus be confident that the treatment effect, while possibly inflated by the exclusion of some studies, is nevertheless not nil. Due to the relatively novel interest in yoga-based interventions as an adjunct treatment for psychiatric disorders, few well-designed, controlled, randomized studies were found. Thus, we can be sure that a large number of null studies do not exist at this time and confident in our finding that yoga therapy has a significant effect as a complementary treatment for psychiatric disorders.

A limitation within the study was the lack of trials investigating specific disorders available for inclusion in the meta-analysis. Insistence that yoga therapy should be conducted under the supervision of a trained instructor only, a factor limiting widespread use of yoga in psychiatric disorders, could be a potential reason for this lack of trials. Of the 10 trials included, most investigated the effect of yoga on depression and/or anxiety. Only 1 trial was found investigating the effects of yoga on schizophrenia. Finally, although several studies were found that investigated PTSD, only 2 included a control group, and 1 was excluded due to lack of information. With such a limited number of trials, we were unable to examine the difference of yoga therapy efficacy for each of the psychiatric disorders of interest. Future meta-analyses should investigate the difference in efficacy of yoga therapy across different psychiatric disorders, the efficacy of different yogabased practices, and the efficacy of other alternative interventions such as tai chi, qigong, and dance.

The findings of this meta-analysis provide support for the use of yoga as an effective adjunct treatment for psychiatric disorders. Yoga may provide an inexpensive, effective alternative to common treatments presently used in the treatment of psychiatric disorders. As the yoga interventions included in the meta-analysis consisted of postures, breathing exercises, meditation, and a varying combination of the components of yoga, it appears that synergistic yoga interventions may have differing degrees of efficacy in comparison to yoga interventions that consist of only 1 single yoga component. Findings in support of alternative and complementary interventions may aid in the treatment of psychiatric disorders presented in this study and may be an aid in the treatment of additional psychiatric disorders in which current treatments are found to be inadequate or to carry severe liabilities.

Yoga therapy has been understudied, and more welldesigned studies are needed before definitive conclusions can be drawn about yoga's use for specific mental illnesses. Future studies should examine dose response and whether more classes per week predict a greater effect. They should also examine head-to-head comparisons of yoga directly to pharmacotherapy. Recently, the US government, the National Institutes of Health, and the US military have turned to complementary and alternative medicine, especially yoga, for the treatment of anxiety and, particularly, PTSD. The National Center for Complementary and Alternative Medicine has recognized the benefits of yoga and currently is funding 30 clinical trials of yoga for various medical conditions. Although research on yoga is still in its infancy, the results to date are promising, and largescale, well-controlled trials should soon follow.

Drug names: imipramine (Tofranil and others).

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