Yoga as an Ancillary Treatment for Neurological and Psychiatric Disorders: A Review

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Yoga is gaining acceptance as an ancillary medical treatment, but there have been few studies evaluating its therapeutic benefits in neurological and major psychiatric conditions. The authors reviewed the literature in English on the efficacy of yoga for these disorders. Only randomized, controlled trials were included, with the exception of the only study of yoga for bipolar disorder, which was observational. Trials were excluded if yoga was not the central component of the intervention. Of seven randomized, controlled trials of yoga in patients with neurological disorders, six found significant, positive effects. Of 13 randomized, controlled trials of yoga in patients with psychiatric disorders, 10 found significant, positive effects. These results, although encouraging, indicate that additional randomized, controlled studies are needed to critically define the benefits of yoga for both neurological and psychiatric disorders.

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Psychopharmacology is a mainstay treatment modality used in the United States for the treatment of neurological and psychiatric disorders. "Atypical" antipsychotic medications, used in the treatment of schizophrenia, bipolar illness, depression, and posttraumatic stress disorder (PTSD), as well as in some neurological disorders, are linked to metabolic side effects such as weight gain, diabetes, and dyslipidemias.[1] First- and second-generation antidepressants are linked to cardiovascular and sexual side effects. Also, the therapeutic benefit of these medications is often incomplete. Thus, there is a clear need for complementary nonpsychopharmacological management of neurological and psychiatric disorders.[2]

Yoga is an ancient practice that has its roots in Hindu religion. The word "yoga" comes from the Sanskrit "yuj," meaning "yoke" or "union." It is believed that "yoga" describes the union between the mind and body, and it is used as a therapeutic intervention in a variety of diseases. Yoga consists of three primary components: *asanas*

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(postures), *pranayama* (breathing exercises), and *dhyana* (meditation).[3] Yoga is thought to treat symptoms of certain neurological and psychiatric disorders through a variety of biological mechanisms related to either the aerobic components of yoga (the changing sequence of *asanas*) or the breathing and meditative components of yoga (*pranayama* and *dhyana*). The aerobic components of yoga enhance mental health via a variety of mechanisms, which may include stimulating the central nervous system release of endorphins, monoamines, and brain-derived neurotrophic factor (BDNF) in the hippocampus.[4–6]

The meditative components of yoga consist of controlled breathing, relaxation, and meditation techniques. Brown and Gerbarg[7,8] suggest multiple possible mechanisms pertaining to these components of yoga: First, controlled breathing and meditative practices lead to a reduction in sympathetic and increase in parasympathetic tone, the latter of which has been associated with emotional regulation and empathic response. Second, these practices cause increases in heart-rate variability (HRV) and respiratory sinus arrhythmia (RSA), low amounts of which have been associated with anxiety, panic disorder, depression, irritable bowel syndrome, early Alzheimer's, and obesity. Finally, they lead to increases in EEG synchrony and coherence, which have been associated with improved integrated brain functioning and problem-solving.

Also, some studies have linked the meditative components of yoga to an increase in melatonin and a decrease in cortisol.[9,10] Increases in melatonin have been shown to influence various biological mechanisms, including promoting sleep, stimulating the immune system by acting as a powerful antioxidant, and decreasing blood pressure.[11,12] Tooley et al.[9] observed significantly higher levels of plasma melatonin in patients immediately after they had completed yogic meditation sessions, as compared with control periods, and speculated on two possible mechanisms causing this effect: First, meditation reduces blood flow to the liver, slowing the metabolism of melatonin. Second, meditative yoga practices have been linked to increases in serotonin, which is converted to melatonin in the pineal gland. Harinath et al.[13] also observed an increase in melatonin levels after a 3-month period of *asanas*, *pranayama*, and meditation (*dhyana*). Harinath similarly speculated that the meditative components of yoga lead to increased levels of melatonin, although possible mechanisms were not discussed.

The meditative components of yoga also have been linked to decreasing levels of cortisol.[14,15] Numerous studies have found a significant positive correlation between levels of cortisol, negative affect, and depression.[16] Bowman et al.[17] observed a significant increase in vagal (parasympathetic) activity in healthy elderly persons after a nonaerobic form of yoga, but not after aerobic exercise. Vagal or parasympathetic activity is responsible for calming the body's stress response systems, and is associated with decreased levels of cortisol.[18–20] This suggests that aspects of yoga outside of aerobic exercise, such as controlled breathing and meditation techniques, are associated with decreased levels of cortisol.

The studies included in this review examined the most commonly practiced forms of yoga in the United States: Hatha yoga, Iyengar yoga, Sudarshan Kriya yoga (SKY), and different types of meditative yoga. Hatha yoga, the most popular form of yoga in the United States, emphasizes the *asanas*, the physical yoga postures.[21] Unlike most exercises, *asanas* are done slowly, in conjunction with breathing exercises (*pranayama*), and are intended to enhance relaxation, awareness, and coordination between the body and mind.[22] Iyengar yoga is a form of Hatha yoga that uses props (e.g. mats, blankets, blocks, belts, and chairs) to help beginners learn the *asanas* gradually and accurately, despite limited experience and flexibility. Iyengar yoga typically involves sitting and standing postures, inversions (shoulder stand, head stand), breathing exercises (pranayama), and a short period of relaxation at the end of each class (savasana).[23] Sudarshan Kriya Yoga (SKY) is composed of a sequence of four breath practices, including slow breathing (Ujjayi) to increase parasympathetic activity, forceful, high frequency breathing (Bhastrika) to induce sympathetic activity and CNS activation, chanting (Om) to decrease sympathetic activity and increase mental alertness, and, finally, a cyclical breath form (Sudarshan Kriya) to harmonize the nervous system. It is thought that this sequence of breath practices provides a neurophysiological "workout" that leads to greater flexibility and plasticity in the nervous system.[7] Finally, meditative yoga includes a variety of attention-control practices that enable participants to focus attention and maintain awareness of the present moment.[24] Participants are encouraged to use techniques such as breath awareness, silent word repetition, and the meditative practice of *surrender*, which involves observing one's thoughts and feelings as they arise, but consciously letting go of them.[25]

Malhotra[26,27] provides greater detail on the distinctive features of yoga, defining it in terms of eight graded

steps: *yama* (self-control, nonviolence, truthfulness, not stealing, chastity, and the avoidance of greed), *niyama* (the complete and regular observance of the afore-said rules), *asana* (posture), *pranayama*, (control of breath), *pratyahara* (restraint), *dharana* (concentration on a single object), *dhyana* (meditation), and *samadhi* (deepest absorptive meditation). He emphasized yoga as one of the oldest psychobiological disciplines and cited some of the first studies examining the physiological effects of yoga. Bagchi and Wenger[28] studied the effects of meditation in 14 yogis who meditated for 14 to 148 minutes over 25 sessions. While the yogis demonstrated normal waking EEG patterns during meditation, they did have an increase in the electrical resistance of the skin, a sign of relaxation. Anand et al.[29] observed one yogi who remained in a sealed, airtight box for 18 hours over two occasions. This yogi's average oxygen utilization was 13.3 L per hour, 6.2 L below his basal requirement, and he showed no signs of hyperpnea or tachycardia when breathing air with decreased oxygen and increased carbon dioxide content. Also, Anand et al.[30] reported that in a study of four yogis who practiced *samadhi* (deepest absorptive meditation), two were able to keep a hand immersed in ice water for 45–55 minutes with no change in EEG alpha activity. These early findings suggested that, through meditative practices, some yogis are able to self-modulate certain physiological processes.

The popularization of yoga in Western cultures is fairly recent. A 2002 survey conducted by the National Center for Health Statistics and the National Center for Complementary and Alternative Medicine found that yoga is one of the top 10 complementary and alternative medicine modalities. Nearly 8% of more than 31,000 people surveyed had used yoga for health benefits. Extrapolation to the entire United States population suggests that more than 15 million adults have used yoga for a variety of conditions, including anxiety disorders, stress, asthma, high blood pressure, back pain, and depression, and as part of an exercise regimen to attain physical fitness while achieving the benefits of relaxation.[31]

Yoga is relatively safe and well-tolerated, with very few side effects when practiced appropriately. Healthy yoga participants should be aware of their individual skill levels to avoid the risks of overstretching, strains, fractures, overheating, dehydration, and decreased blood glucose levels.[32] Although the aerobic exercise involved in yoga leads to numerous health benefits, physical activity can be associated with impaired mental health. Although exercise is frequently associated with improved mood, some studies have documented worsened mood as a result of high-intensity exercise lasting more than 10 days.[33] Yoga often involves inverted poses, where the head is lower than the rest of the body, increasing blood circulation to the brain. Although thought to be rejuvenating and beneficial for most healthy participants, inverted poses carry risks for specific populations. Inverted poses increase intraocular pressure, which can worsen glaucoma, owing to raised episcleral venous pressure and choroidal volume by vascular enlargement.[34] Also, such poses put strain on the heart to circulate blood through the inverted body. Most participants claim this leads to a feeling of revitalization and a healthy facial glow, but in participants with hypertension or hypotension, these inversions pose the risk of a sudden drop in blood pressure, which can induce a stroke or heart attack.[32] Yoga also lowers blood glucose levels, and although usually a health benefit, it can pose a danger for diabetic patients.[35] Thus, it is always recommended that persons with medical problems such as glaucoma, hypertension, or hypotension, retinal detachment, severe spinal stenosis, a risk of blood clots, or diabetes consult a physician before attempting any yoga pose that could be hazardous.[31]

In recognition of these risks of yoga for some individuals, there is a growing trend toward modifying yoga for their needs. Yoga is a highly individualized form of exercise; different forms of yoga have been used to complement the treatment of patients with cancer, asthma, cardiac problems, and non–insulin-dependent diabetes.[35–38] An increasingly popular trend has been prenatal yoga, wherein removing difficult poses and emphasizing meditative practices prevent women from putting excess stress on their backs or abdominal muscles, or overstretching. Recent controlled studies have demonstrated that an integrated approach to yoga reduces pregnant women's perceived stress and improves their adaptive autonomic responses to stress.[39,40] Whether they are generally healthy or have some illness or disability, it is important for all practitioners to be conscious of their own bodies' abilities and restrictions to ensure that they practice safely.

Yoga intervention in chronic medical diseases has received considerable attention. Yang[41] reviewed 32 articles published between 1980 and 2007 that cite yoga as an intervention for obesity, hypertension, hyperglycemia, and hypercholesterolemia, which are common risk factors for cardiovascular disease and diabetes. Yoga

interventions were effective in reducing body weight and blood pressure, glucose, and cholesterol. In contrast, research on yoga as an adjunct treatment for neurological and psychiatric disorders is relatively recent and less well-studied, and is thus the focus of this review.

Herein, we review the literature on the efficacy of yoga for neurological and major psychiatric disorders. Major psychiatric disorders were defined as major depression, schizophrenia, posttraumatic stress disorder, and bipolar disorder. Anxiety was considered a component of the other disorders. Trials were identified by a search of PubMed/Medline, PsychInfo, Cochrane Control Trials Register, and Google Scholar. Earlier reviews of yoga as a therapeutic intervention found that existing studies varied greatly in research design and procedure, and thus that it was difficult to draw any generalizable conclusions.[42–44] In order to increase homogeneity among studies, only randomized, controlled trials were included, with the exception of one observational study of yoga for bipolar disorder, for which there were no randomized, controlled trials. Also, only trials that examined the effects of Hatha yoga, Iyengar yoga, Sudarshan Kriya yoga (SKY), or meditative yoga were included. Trials were excluded if they were not reported in English or if yoga was not the central component of the intervention.

Seven randomized, controlled trials tested the benefits of yoga in patients with neurological disorders, and six found significant positive effects; 13 randomized, controlled trials tested the benefits of yoga in patients diagnosed with severe mental illness, and 10 found significant, positive effects, defined as significant improvement in the yoga group alone on one or more outcome measures. The results of this review, although encouraging, indicate that additional randomized, controlled studies are needed to critically define the benefits of yoga for the treatment of both neurological and psychiatric disorders.

YOGA FOR THE TREATMENT OF NEUROLOGICAL DISORDERS

Table 1 summarizes the studies that have implemented yoga as a therapeutic intervention in treating or alleviating the symptoms of neurological disorders.

Multiple Sclerosis (MS)

MS is an autoimmune neurodegenerative disease characterized by demyelinating lesions of the central nervous system that are disseminated throughout the white matter in space and time.[45] As a result, patients present with varying symptoms of fluctuating severity, including hypoesthesia, muscle weakness, abnormal muscle spasms, ataxia, dysarthria, dysphagia, nystagmus, optic neuritis, diplopia, fatigue, and chronic pain. MS lesions can be identified on standard MRI only when there is active demyelination. Initial attacks often are transient and may improve spontaneously. Many risk factors have been identified for MS; however, no cause has yet been found. Many believe that it results from a combination of environmental and genetic factors.

Oken et al.[46] conducted the earliest randomized, controlled trial evaluating the effects of yoga in patients with MS. Sixty-nine patients with MS and an Expanded Disability Status Score[47] $\leq$6.0 were randomly assigned to one of three groups for 6 months: weekly Iyengar yoga class along with home practice, weekly exercise class using a stationary bicycle along with home exercise, or a waiting-list control group. Outcomes were based on attention, physiologic measures of alertness, Profile of Mood States,[48] State–Trait Anxiety Inventory,[49] Multi-Dimensional Fatigue Inventory,[50] and Short Form-36 Health-Related Quality of Life.[51] There were no significant effects of either of the active interventions on the primary outcome measures of attention, alertness, or mood. However, MS patients participating in the yoga and exercise classes did show significant improvement in secondary measures of fatigue, as compared with the control group ($p < 0.001$).

In the only other randomized, controlled trial examining the effects of yoga in patients with MS, Velikonja et al.[52] compared the effects of sports climbing (SC) and yoga on measures of spasticity, cognitive impairment, mood changes, and fatigue in 20 relapsing-remitting or progressive MS patients with Expanded Disability Status Score (EDSS) <6 and EDSS Pyramidal Functions Score (EDSSpyr) >2. Subjects were randomly assigned to an SC or yoga group, with classes once a week for 10 weeks. The yoga group demonstrated a significant increase in selective-attention performance after 10 weeks (p=0.005), whereas the SC group demonstrated significant improvement in fatigue level (p=0.015) and EDSSpyr scores (p=0.046). Neither group demonstrated significant improvement in spasticity, executive functioning, or mood.

Migraine

Latha et al.[53] conducted the earliest randomized, controlled trial of yoga for the treatment of migraine and tension

TABLE 1. Published Studies Evaluating Yoga Intervention for the Treatment of Neurological Disorders

Study	Design	Subject Groups	Groups	Duration	Results
Multiple Sclerosis (MS)					
Oken *et al.* 2004[46]	Randomized, controlled trial	69 patients with MS	Iyengar yoga versus stationary bike and at-home exercise versus wait-list control	6 months	No significant effect of yoga on primary outcome measures of attention, alertness, or mood as compared with exercise and control group. Significant improvement in secondary measures of fatigue in yoga and exercise groups compared with control group ($p < 0.001$).
Velikonja *et al.* 2010[52]	Randomized, controlled trial	20 patients with relapsing-remitting or progressive MS	Hatha yoga versus sport climbing (SC)	10 weeks	Significant increase in selective-attention performance in yoga group alone (p=0.005). Significant improvement in EDSSpyr (p=0.046) and fatigue (p=0.015) in SC group alone.
Migraine					
Latha *et al.* 1987[53]	Randomized, controlled trial	20 patients with migraine or tension headaches	Hatha yoga versus control	4 months	Significant reduction in headache frequency, duration, and intensity in yoga group, as compared with controls ($p < 0.01$). Significant reduction in medication intake, number of somatic symptoms accompanying headache, and stress perception in yoga group vs. controls (p values not specified).[a]
John *et al.* 2007[54]	Randomized, controlled trial	72 migraine patients without aura	Hatha yoga versus self-care	3 months	Significant reductions in headache intensity, headache frequency, pain rating index, affective pain rating index, total pain rating index, anxiety and depression scores, and symptomatic medication use in yoga group vs. controls (all p values <0.001).
Epilepsy					
Panjwani *et al.* 1996[58]	Randomized, controlled trial	32 patients with idiopathic epilepsy	Sahaja (meditative) yoga versus exercises mimicking Sahaja yoga versus controls	6 months	Significant decrease in seizure frequency in Sahaja yoga group ($p < 0.001$), as compared with controls (p=0.043).
Lundgren *et al.* 2008[60]	Randomized, controlled trial	18 patients with drug-refractory epilepsy	Hatha yoga versus Acceptance and Commitment Therapy (ACT)	5 weeks	Significant reduction in seizure index for ACT and yoga groups ($p < 0.01$ for both). Significant increase in SWLS quality of life score ($p < 0.05$) for yoga group alone. Significant improvement in WHOQOL-BREF quality of life score for ACT group alone ($p < 0.01$).
Sathyaprabha *et al.* 2008[63]	Controlled trial; patients assigned alternately to groups	34 patients with refractory epilepsy	Hatha yoga versus routine exercise	10 weeks	Significant improvements in max:min ratio (p=0.02), deep-breathing ratio (p=0.04), and seizure frequency ($p < 0.001$) in yoga group alone. No significant improvement in Valsalva ratio or change in standing systolic blood pressure in yoga or exercise group.

[a]Indicates studies in which p values were not specified.

headaches. Twenty patients suffering from these headaches were randomly assigned to a yoga or control group for 4 months. Patients were assessed for headache activity (frequency, duration, and intensity), sources of stress, coping patterns, and somatic symptoms before and after the intervention. Patients in the yoga group demonstrated significant reductions in headache frequency, duration, and intensity, as compared with the control group ($p < 0.01$). Patients in the yoga group also demonstrated significant reductions in medication intake, number of somatic symptoms accompanying headache, and stress perception (p values not specified).

John et al.[54] conducted a later randomized, controlled trial evaluating yoga for the treatment of migraines. Seventy-two migraineurs without aura were randomly assigned to yoga therapy or self-care for 3 months. Primary outcomes were headache frequency (self-assessed headache diary), severity of migraine (0–10 scale), and pain.[55] Secondary outcomes were anxiety and depression[56] and a medication score. After adjustment for baseline values, compared with the self-care group, participants in the yoga group demonstrated significantly improved scores on headache intensity, headache frequency, pain rating index, affective pain rating index, total pain rating index, anxiety and depression scores, and symptomatic medication use (all p values <0.001). No other trials of yoga for the treatment of migraines have been published to-date.

Epilepsy

Yoga also has been assessed for the treatment of epilepsy, a neurological disorder characterized by recurrent, unprovoked seizures due to abnormal neuronal activity in the brain. Although epileptic seizures are unprovoked, there are certain environmental triggers that may increase the likelihood of seizures,[57] such as stress and anxiety. Panjwani et al.[58] conducted the earliest randomized, controlled trial of adjunctive yoga for the treatment of epilepsy, evaluating the effect of Sahaja yoga meditation on seizure control and EEG alteration in 32 patients with idiopathic epilepsy. Subjects were randomly divided into three groups: Group I (N=10) practiced Sahaja yoga for 6 months; Group II (N=10) practiced exercises mimicking Sahaja yoga for 6 months; and Group III (N=12) served as the control group. Group I reported significantly improved seizure frequency, as compared with the control group ($p=0.043$), and only Group I reported a significant improvement in seizure frequency after 6 months of intervention, as compared with baseline ($p < 0.001$).[59] EEG power spectral analysis in Group 1 showed a shift in frequency from 0–8 Hz to 8–12 Hz; that is, the alpha and beta frequencies increased as compared with the delta and theta frequencies. Percentage D power decreased, and percentage A power increased. No significant changes in EEG were found in the non-yoga groups (II and III).[58]

Lundgren et al.[60] conducted a randomized, controlled trial comparing Acceptance and Commitment Therapy (ACT) with yoga for the treatment of epilepsy. Subjects were assigned to an ACT group (N=10) or yoga group (N=8) for 5 weeks. Outcome measures were seizure index (frequency × duration) and quality of life (Satisfaction With Life Scale [SWLS],[61] World Health Organization Quality of Life instrument, Short Version [WHOQOL-BREF][62]). Both ACT and yoga significantly reduced seizure index over time ($p < 0.01$ for both), although ACT reduced the seizure index significantly more than yoga ($p < 0.05$). Although the ACT group demonstrated a significant increase in quality of life as measured by the WHOQOL-BREF ($p < 0.01$), the yoga group demonstrated a significant increase in quality of life as measured by the SWLS ($p < 0.05$).

Finally, Sathyaprabha et al.[63] examined the effects of yoga on autonomic functioning in 34 patients with refractory epilepsy. Subjects were alternately assigned to either a yoga group or routine exercise group, with daily classes for 10 weeks. The yoga group demonstrated significant improvements in heart-rate max:min ratio (longest electrocardiogram RR interval to shortest RR interval after standing; $p=0.02$), deep-breathing ratio (longest RR interval occurring during expiration to shortest RR interval occurring during inspiration; $p=0.04$), and seizure frequency ($p < 0.001$). Neither group demonstrated significant improvements in Valsalva ratio (longest RR interval during Valsalva maneuver to shortest RR interval during Valsalva or immediately afterward), or change in standing systolic blood pressure.

Taken together, these studies suggest that yoga may be a beneficial adjunctive treatment for several neurological disorders. There are, however, a paucity of controlled studies, and they use different methodologies (types of yoga, lengths of treatment, outcome measures). Additional controlled studies for each of the neurological disorders discussed above are thus needed.

YOGA FOR THE TREATMENT OF PSYCHIATRIC DISORDERS

Table 2 summarizes the studies that have implemented yoga as a therapeutic intervention in treating or alleviating the symptoms of psychiatric disorders.

Major Depression

In the earliest randomized, controlled trial evaluating the effects of yoga in patients with depression, Broota and Dhir[64] compared the effects of Broota's Relaxation Technique (BRT; consisting of four exercises adapted from yoga, including deep breathing, bow asana, raising the legs, and cycling combined with autosuggestion) with Jacobson's Progressive Relaxation (JPR) (non-yoga) and a control intervention (narrating present complaints and state-of-mind) in 30 outpatients with neurotic or reactive depression, over three 20 minute sessions. The method of randomization was not specified, and there were no baseline comparisons of the groups. Outcomes were based on percent symptom-reduction on a checklist of 26 common symptoms of depression taken from the DSM–III and ICD–9 completed by each patient before and after each session. Significant reductions in symptoms of depression followed in both the BRT and JPR groups, as compared with the control group ($p < 0.05$). The authors reported that the BRT group was more effective than the JPR group, although p values were not specified.

Khumar et al.[65] conducted a randomized, controlled trial of savasana yoga (rhythmic breathing and relaxation) in 50 women university students with severe depression. Subjects were assigned to a group that practiced savasana for 30 minutes daily for 30 days or to a control group. Outcome measures were the Amritsar Depression Inventory,[66] (a 30-item Yes/No questionnaire developed in the Punjab in India from 50 statements that are common expressions among Punjabi speakers with depressive states) and the Zung Self-Rating Depression Scale[67] (a self-reported 20-item scale). Only the yoga group demonstrated significant within-group reductions in mid- and post-treatment depression scores (p=0.01). The yoga group also demonstrated significant reductions in mid- and post-treatment depression scores, as compared with the control group ($p < 0.01$).

Janakiramaiah et al.[68] conducted a randomized, controlled trial comparing the effects of Sudarshan Kriya Yoga (SKY) with electroconvulsive therapy (ECT) and drug therapy with imipramine (IMI) for the treatment of depression. Forty-five patients with DSM–IV melancholic depression and a score of ≥17 on the Hamilton Rating Scale for Depression (Ham-D)[69] were randomized to one of the three groups for 4 weeks. Significant reductions in total Beck Depression Inventory (BDI)[70] and Ham-D scores occurred in all three groups (all p values=0.0001), with no significant difference in total BDI or Ham-D scores across groups (NS for BDI and Ham-D). Remission rates (total Ham-D score of ≤7) at the end of the trial were ECT: 93%, IMI: 73%, and SKY: 67%. SKY thus offered an overall benefit, but it was less than the benefit of ECT or IMI.

Rohini et al.[71] compared full Sudarshan Kriya Yoga (SKY) with partial SKY in a randomized, controlled trial of 30 patients suffering from DSM–IV major depressive disorder and a score of 18+ on the Ham-D. Participants completed the BDI and the Beck Anxiety Inventory[72] weekly for 4 weeks. Participants in both groups demonstrated significant decreases in depression and anxiety scores after 4 weeks (all p values <0.001), with no significant differences between full and partial SKY treatment groups at baseline, 1, 2, 3, or 4 weeks.

Sharma et al.[73] evaluated the effect of yoga on neurocognitive functions in a randomized, controlled trial of 30 patients with major depression. Patients were divided into two groups: Group I practiced Sahaj Yoga meditation and received conventional antidepressant medication, and Group II only received conventional antidepressant medication. After 8 weeks, both groups demonstrated significant improvements in the Letter Cancellation Test, Trail-Making Test A, and Trail-Making Test B. The yoga group also demonstrated a significant improvement in the Reverse Digit Span Test ($p < 0.05$) and a significant reduction in Ham-D score, as compared with the control group (p=0.003).

Finally, Butler et al.[24] conducted a 9-month randomized, controlled trial comparing the effects of three groups: yoga + meditation + psychoeducation, versus group therapy + hypnosis + psychoeducation, versus psychoeducation alone, in 46 patients with long-term depressive disorders of low-to-moderate severity. Patients in the yoga group experienced significantly more remissions than patients in the other two groups ($p < 0.03$). The authors suggest that yoga combined with meditation may be a promising treatment for low-to-moderate-level depression.

Also presented in Table 2 are three randomized, controlled trials that examined the effects of yoga in

TABLE 2. Published Studies Evaluating Yoga Intervention for the Treatment of Psychiatric Disorders

Study	Design	Subjects	Groups	Duration	Results
Mood Disorders					
Broota and Dhir 1990[64]	Randomized, controlled trial	30 outpatients with neurotic or reactive depression	Broota relaxation (meditative) versus Jacobson's progressive relaxation (meditative) versus control	3–20 minute sessions	Significant reduction in symptoms of depression in both Broota and Jacobson groups, as compared with controls ($p < 0.05$). Broota group more effective than the Jacobson group.[c]
Khumar *et al.* 1993[65]	Randomized, controlled trial	50 female university patients with severe depression	Savasana yoga (meditative) versus control	30 days	Significant within-group reductions in mid- and post-treatment Amritsar Depression Inventory and Zung Self-Rating Depression Scale scores ($p=0.01$) in yoga group alone. Significant reductions in mid- and post-treatment depression scores for yoga group vs. control group ($p < 0.01$).
Janakiramaiah *et al.* 2000[68]	Randomized, controlled trial	45 patients with melancholic depression	Sudarshan Kriya yoga versus electroconvulsive therapy (ECT) versus drug therapy with imipramine (IMI)	4 weeks	Significant reductions in Beck Depression Inventory (all p values=0.0001) and Hamilton Rating Scale for Depression (Ham-D) scores (all p values=0.0001) in yoga, ECT, and IMI groups, with no significant between-group differences.
Rohini *et al.* 2000[71]	Randomized, controlled trial	30 patients with major depression	Full Sudarshan Kriya yoga (SKY) versus partial SKY	4 weeks	Significant decreases in BDI and Beck Anxiety Inventory scores in both full and partial SKY treatment groups (all p values <0.001), with no significant between-group differences.
Woolery *et al.* 2004[74]	Randomized, controlled trial	28 patients with mild depression[a]	Iyengar yoga versus wait-list control	5 weeks	Significant decreases in self-reported symptoms of depression and trait anxiety in yoga group, as compared with control group (all p values <0.001).
Sharma *et al.* 2006[73]	Randomized, controlled trial	30 patients with major depression	Sahaj (meditative) yoga and antidepressant medication versus antidepressant medication alone	8 weeks	Significant reduction in Ham-D scores ($p=0.003$) and significant improvement in Reverse Digit Span test ($p < 0.05$) in yoga group, as compared with control group.
Butler *et al.*, 2008[24]	Randomized, controlled trial	46 patients with long-term depressive disorders	Meditative yoga and psychotherapy versus group therapy with psychoeducation versus psychoeducation alone	9 months	Significant increase in remissions in meditation group, as compared with control group ($p < 0.03$).
Kozasa *et al.* 2008[75]	Randomized, controlled trial	22 patients with anxiety complaints[a]	Siddha Samadhi (meditative) yoga versus wait-list control group	1 month	Significant reduction in anxiety, depression, and tension scores, and significant increase in well-being scores in yoga group, as compared with control group (all p values <0.05).

TABLE 2. Published Studies Evaluating Yoga Intervention for the Treatment of Psychiatric Disorders (Continued)

Study	Design	Subjects	Groups	Duration	Results
Javnbakht *et al.* 2009[76]	Randomized, controlled trial	65 women with anxiety and depression symptoms[a]	Hatha yoga versus wait-list control	2 months	Significant decreases in State-anxiety ($p=0.03$) and Trait-anxiety ($p<0.001$) scores in yoga group, as compared with control group.
Schizophrenia					
Duraiswamy *et al.* 2007[79]	Randomized, controlled trial	61 patients with schizophrenia	Hatha yoga versus physical exercise therapy	4 months	Significantly less psychopathology and significantly greater social and occupational functioning and quality of life (all p values <0.01) in yoga group vs. physical exercise group.
Visceglia and Lewis 2011[85]	Randomized, controlled trial	18 patients with schizophrenia	Hatha yoga versus wait-list control	8 weeks	Significant improvements in PANSS Total scores ($p<0.000$) and subscale scores of Positive syndrome ($p=0.02$), Negative syndrome ($p<0.01$), general psychopathology ($p<0.00$), activation ($p<0.04$), paranoia ($p<0.01$), and depression ($p<0.02$) in yoga group, as compared with control group. Significant improvements in WHOQOL-BREF Physical Health ($p<0.04$) and Psychological domains ($p<0.01$) in yoga group vs. control group.
Vancampfort *et al.* 2011[86]	Randomized, repeated-measures trial	40 patients with schizophrenia	Hatha yoga versus aerobic exercise versus control	1 session	Significant improvements in state anxiety ($p < 0.0001$), psychological stress ($p < 0.0001$), and subjective well-being ($p < 0.0001$) after both yoga and exercise interventions compared with the control condition. No significant differences between yoga and aerobic exercise conditions.
Posttraumatic Stress Disorder (PTSD)					
van der Kolk *et al.* 2006[88]	Randomized, controlled trial	8 women with PTSD	Hatha yoga versus Dialectic Behavior Therapy (DBT)	8 weeks	Significant decreases in frequency of intrusions and severity of hyperarousal symptoms ($p<0.05$ for both) in yoga group compared with DBT group.
Bipolar Disorder					
Russell and Browne 2005[92]	Observational study	100 patients with bipolar disorder without illness episodes for 2 years	No intervention[b]	N/A	12 patients treated their bipolar disorder with complementary therapies instead of medication. Yoga cited as one of the most commonly-used complementary treatments.

PANSS: Positive and Negative Syndrome Scale; WHOQOL-BREF: World Health Organization Quality of Life instrument, Short Version.
[a]Indicates studies in which participants were not diagnosed with psychiatric illness but reported mood disorder symptoms.
[b]Indicates studies in which there was no control or comparison group.
[c]Indicates studies in which p values were not specified.

individuals who were not diagnosed with psychiatric illness, but who had mood-disorder symptoms.[74–76] All three studies found significant effects of yoga.

Schizophrenia

Several studies have reported yoga to be beneficial for patients with schizophrenia, yet only three randomized, controlled trials have examined the effects of yoga for patients with schizophrenia.[77,78] Duraiswamy et al.[79] randomly assigned 61 moderately ill DSM–IV schizophrenia patients to either yoga therapy (N=31) or physical exercise therapy (N=30) for 4 months. All patients had been on antipsychotic medication for several months and had experienced no change in medication dose for at least 4 weeks before entry into the study or throughout the study period. The two groups had similar baseline demographic and illness characteristics. Psychopathology was blindly assessed by a rater using the Positive And Negative Syndrome Scale for Schizophrenia[80] at baseline and at the end of the study. The patients also were rated on social and occupational functioning via the Social and Occupational Functioning Scale,[81] side effects via the Simpson Angus Scale for Extrapyramidal Symptoms,[82] and the Abnormal Involuntary Movements Scale (AIMS),[83] and quality of life via the WHO Quality of Life BREF Version.[84] At the end of the 4-month trial, participants who received yoga therapy demonstrated significantly less psychopathology and significantly greater social and occupational functioning and quality of life than those in the physical exercise therapy group (all p values <0.01). Yoga intervention thus may be an effective adjunct therapy for patients with schizophrenia.

Visceglia and Lewis[85] conducted a randomized, controlled pilot study in which they randomized 18 patients with schizophrenia to either an 8-week Yoga Therapy (YT) program or Wait-List group (WL). The YT intervention consisted of yoga postures, breathing exercises, and relaxation. At baseline and 8 weeks, patients' symptoms were measured with the Positive and Negative Syndrome Scale (PANSS)[80] and the World Health Organization Quality of Life BREF questionnaire (WHOQOL-BREF).[84] After 8 weeks, the YT group demonstrated significant improvements in PANSS total scores ($p<0.000$) and subscale scores of positive syndrome ($p=0.02$), negative syndrome ($p<0.01$), general psychopathology ($p<0.00$), activation ($p<0.04$), paranoia ($p<0.01$), and depression ($p<0.02$), as compared with the WL group. The YT group also demonstrated significant improvements in WHOQOL-BREF physical health ($p<0.04$) and psychological domains ($p<0.01$), as compared with the WL group.

Finally, Vancampfort et al.[86] conducted a randomized, repeated-measures study of the effects of yoga and aerobic exercise on state anxiety, psychological stress, and subjective well-being in 40 patients with schizophrenia. Subjects participated in a single 30-minute Hatha yoga session, a 20-minute aerobic exercise session, and a 20-minute no-exercise control session in random order. The repeated-measures design allowed participants to act as their own controls and thus eliminated intergroup variability. State anxiety was assessed by the State Anxiety Inventory,[72] and psychological stress and positive well-being were measured using the Subjective Exercise Experiences Scale.[87] After both the yoga and exercise intervention, patients exhibited significant improvements in State anxiety ($p<0.0001$), psychological stress ($p<0.0001$ for both), and subjective well-being ($p<0.0001$) versus the control condition. There were, however, no significant differences between the yoga and aerobic exercise conditions.

Posttraumatic Stress Disorder (PTSD)

van der Kolk et al.[88] conducted the only randomized, controlled trial to-date examining the effects of yoga for the treatment of PTSD. Eight female patients (ages 25 to 55) with PTSD were randomly assigned to either group-therapy based on dialectical behavior therapy (DBT) or 75 minutes of Hatha yoga, weekly for 8 weeks. Participants were rated on the Davidson Trauma scale,[89] the Positive and Negative Affect Schedule (PANAS),[90] and the Trauma Center Body Awareness Scale.[91] Compared with the DBT group, participants in the yoga group demonstrated significant decreases in frequency of intrusions and severity of hyperarousal symptoms pre-to post-treatment ($p<0.05$ for both). There were no significant changes in PANAS or body awareness.

Bipolar Disorder

Last, Russell and Browne[92] conducted a qualitative research study of the most effective strategies used to manage bipolar disorder. They found that of 100 participants diagnosed with bipolar disorder who managed to stay well for at least 2 years, 12 participants treated their bipolar disorder with complementary therapies instead of medication, one of the most common treatments being yoga. In 2008, Andreescu et al.[93] noted that there have been no published research studies of yoga for the treatment of bipolar disorder.

CONCLUDING REMARKS AND FUTURE DIRECTIONS

On the basis of the literature published to-date, we conclude that yoga shows promise in treating the symptoms of several neurological and psychiatric disorders. There have been seven published, randomized controlled trials of yoga for the treatment of neurological disorders, six of which found significant effects for yoga. There have been 13 published, randomized controlled trials of yoga for the treatment of psychiatric illnesses and symptoms, 10 of which found significant treatment effects for yoga, defined as significant effects of the yoga group alone on one or more outcome measures. Almost all the studies were very small, and three of the psychiatric studies included participants who had not been diagnosed with psychiatric illness but who reported mood-disorder symptoms.

The results suggest that yoga may be an effective adjunct intervention for major depression, as seven of the nine randomized, controlled trials found significant positive effects of the yoga intervention alone, in spite of the different types of yoga used. In light of these results, clinicians may consider suggesting yoga as an adjunct treatment option for patients with major depression. Only three randomized, controlled trials of yoga were found for epilepsy and schizophrenia, and only two were found for multiple sclerosis and migraine. Only one randomized, controlled trial of yoga was found for posttraumatic stress disorder, and no randomized, controlled trials of yoga were found for bipolar disorder. There is a clear need for future randomized, controlled studies to investigate the effect of yoga on these disorders, especially in posttraumatic stress disorder and bipolar disorder.

In recent years, the Department of Veterans Affairs, the National Institutes of Health (NIH), and the Department of Defense have begun studying complementary and alternative medical techniques, especially yoga, for the treatment of anxiety and PTSD. The NIH National Center for Complementary and Alternative Medicine is currently funding 30 clinical trials of yoga for various medical conditions. Only two trials, however, are for psychiatric disorders (one for PTSD and one for bipolar disorder). Additional studies are needed to answer the following: Do different types of yoga have different efficacies in treating neurological and psychiatric disorders? Which specific neurological and psychiatric disorders are improved by yoga? For how long and at what frequency does yoga need to be practiced to achieve significant effects?

Given the initial positive results of yoga interventions identified in this review, as well as their relatively minimal side effects, yoga interventions likely will continue to show their worth as effective adjunctive treatment options for neurological and psychiatric disorders.

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