



A Review of Randomized Controlled Trial to Evaluate the Effectiveness of Yoga in Controlling Seizures in Patients with Epilepsy

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KEYWORDS

Epilepsy, yoga, seizure frequency, quality of life, adult, children

ABSTRACT

Yoga, one of the non-pharmacological therapies for epilepsy, has been believed to be an adjunctive therapy to reduce seizure frequency and duration in adults with epilepsy. The latest review of some studies on that subject was published earlier in 2017, but this reviewed the old studies that were published more than ten years ago. So, it is necessary to update the review to find out how effective yoga is in controlling seizures for epilepsy. This review is made to evaluate the effectiveness of yoga in controlling seizures in adult and children with epilepsy. We performed two randomized controlled trial studies selected from PubMed, Cochrane, and Scopus, according to eligibility criteria through PRISMA Flowchart steps. In the intervention group, yoga shows effects that could reduce the frequency and duration of seizures compared to the control group with sham yoga treatment or without any additional treatment. Unfortunately, the detailed characteristics of the participants and the intervention (frequency and duration of yoga) in each study are heterogeneous. A multicentre and well-randomized study that recruits a sufficient number of patients, uses appropriate research methods, and defines explicit inclusion and exclusion criteria is proposed to be conducted. It also will be essential to help reinforce the evidence of yoga's effectiveness as adjunctive therapy in controlling or reducing the frequency and duration of seizures in epilepsy.

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INTRODUCTION

One of the most common neurological diseases, epilepsy, affects people of all ages, races, social classes, and geographical locations (Beghi, 2020). The brain condition known as epilepsy is defined by an enduring predisposition to generate seizures and by the neurobiologic, cognitive, psychological, and social consequences of seizure recurrences (Mirawati et al., 2023). The prevalence of epilepsy differs significantly among countries depending on the local distribution of risk and etiologic factors, the number of seizures at diagnosis, and consideration of whether only active epilepsy (active prevalence) or also cases in remission are included in the lifetime prevalence (Beghi, 2020). The incidence of epilepsy was higher in low/middle-income countries (LMIC) than in high-income countries (HIC), which was explained by the different structure of populations at risk and a greater exposure to perinatal risk factors, higher rates of central nervous system infections, and traumatic brain injury in LMIC. The incidence of epilepsy was also higher in the lowest socioeconomic classes in HIC (Beghi & Hesdorffer, 2014). Based on age group, the incidence of epilepsy was higher in the youngest and oldest age-groups (Fiest et al., 2017), with peaks at ages 5–9 years and at older than 80 years (“Global, Regional, and National Burden of Epilepsy, 1990–2016,”

2019). The prevalence of epilepsy was slightly higher in studies of persons over the age of 18 compared to those under 18 (Fiest et al., 2017).

Epilepsy is typically treated with pharmacological treatment in the form of medicines. This is frequently regarded as the primary epilepsy treatment option. Drugs like valproic acid and carbamazepine are frequently utilized in epileptic situations. By blocking or modulating sodium channels and inhibiting voltage-gated sodium channels, these two medications can lower the incidence of recurrent epilepsy episodes by reducing neuronal excitability. However, in addition to their effects on epilepsy, these pharmacological therapies can cause side effects like nausea, vomiting, dizziness, or even worse, an exacerbation of heart failure when using carbamazepine, or neurological side effects like encephalopathy and coma when using valproic acid (Maan et al., 2024). Because of the intensity and number of adverse effects associated with current pharmacological epilepsy treatment, non-pharmacological therapy may be an add-on to pharmacological treatment, which has fewer side effects than pharmaceutical therapy, to help control seizures as the main focus.

There are many non-pharmacological therapies for epilepsy that have been applied. Behavior interventions (psychobehavioral modalities, yoga and meditation, EEG biofeedback, and music therapy), neuromodulation therapies (vagus nerve stimulation (VNS), responsive neurostimulation therapy (RNS), and transcranial magnetic stimulation therapy (TMS)), and metabolic therapies (ketogenic diet and anaplerotic diet) have shown significant seizure reduction, improvement in multiple quality of life, and cognitive domain (Alqahtani et al., 2020; Haut et al., 2019). Those therapies were used as adjunctive or complementary therapy for epilepsy. It is essential to develop, assess, and implement those complementary therapies for epileptic patients as part of their everyday medical treatment of epilepsy. However, the previously mentioned non-pharmacological treatments are unable to fully resolve the patient's epilepsy problem in a way that is comfortable for them. There are some drawbacks, such as in cases where patients have reflex epilepsy, which can cause seizures when exposed to certain stimuli such as sudden loudness, sudden light, and sudden contractions (Okudan & Özkara, 2018).

Despite the shortcomings of those non-pharmacological therapies mentioned earlier, yoga, an ancient traditional Indian psychophilosophical-cultural method as a mind-body practice consisting of positive behavioral modification (*yamas* and *niyamas*), physical posture practice (*asanas*), breath regulation (*pranayama*), sensation control (*pratyahara*), and meditative practices (*dharana dhyana* and *samadhi*) (Kulal et al., 2021; Patwardhan, 2017), has many superiorities, such as it can be a home-based practice that is easily performed (Wadhen & Cartwright, 2021). Specifically in epilepsy, the potential of yoga as a complementary alternative therapy uniting body, mind, soul, and spirit (Perkins, 2020) has been unveiled since it can lower stress, improve quality of life, reduce psychiatric difficulties, decrease seizure frequency by stimulating the vagus nerve, increase central inhibitory Gamma-Aminobutyric acid (GABA) levels, alter blood flow of the central nervous system, and lead to a shift in autonomic balance toward relative parasympathetic dominance (Farnia et al., 2021; Kanhere et al., 2018; Kulal et al., 2021). Epilepsy has neurological, cognitive, psychological, and social consequences that affect the quality of life well beyond the occurrence of seizures in people with epilepsy. Living with epilepsy faces stigma, common public misunderstanding, lack of social support, social isolation, embarrassment, fear, and discrimination (Strzelczyk et al., 2023). It is estimated that approximately 50% of people with epilepsy present with at least one comorbidity, which include cognitive, psychiatric, and physical disorders (Keezer et al., 2016). The significant impact of yoga in reducing seizure frequency greatly influences a person's quality of life, as seizure

frequency is one of several factors, including seizure severity, stigmatization, and cognitive impairment, that affect the quality of life in patients with epilepsy, making it a crucial concern (Gosain & Samanta, 2022; Singh & Pandey, 2017). Frequent seizures can lead to various physical, psychological, and social complications (Prathikanti et al., 2017).

Review of the yoga's effectiveness on seizure (frequency and duration) reduction in patients with epilepsy had been done and was last published in 2017 (Panebianco et al., 2017). This review performed two old studies that had been conducted more than 10 years ago and the two were subjected to adult groups. It stated that the number of participants experiencing a decrease in the frequency and duration of seizures, even seizure-free, more in the group of participants who received yoga intervention than in the control group (sham yoga and no treatment).

The update review performing the new studies is needed to record and see the progress or any differences in the result about investigation of post-yoga's effect on the frequency and duration of seizures in epilepsy. Therefore, this review aims to evaluate the effectiveness of yoga in controlling seizures in epilepsy. This review presents recent studies with different types of age groups to see the effects of yoga in different age groups as well considering the incidence of epilepsy described by Fiest et al., 2017 was higher in the youngest and oldest age-groups.

METHOD

Searching method

In this systematic review of randomized controlled trials (RCTs), the effectiveness of yoga in improving the quality of life in adults with epilepsy was investigated. The electronic databases of Cochrane, PubMed, and Scopus libraries were systematically searched for studies through 1st December 2023 using the core search terms "Yoga" AND "Epilepsy". Manual searches reviewed the reference lists of retrieved studies to select any additional eligible studies.

Selection of studies

The reviewers independently conducted the literature search and study selection. The participants, intervention, control, outcome, and study design (PICOS) determined the selection process. The inclusion criteria for a study are: (1) The study was conducted or published in the period 2014-2024 (2) Patients diagnosed with epilepsy (adults and children); (3) Age group of 8 to 60 years; (4) all types of epilepsy; (5) RCT study. There are also exclusion criteria for the study: (1) ongoing studies; (2) Pilot study; (3) Other design studies besides RCT study; (4) Patients who were unwilling to provide consent or practice yoga; (5) Patients who have practiced yoga/meditation before enrolment; (6) Patients with an ongoing progressive illness, mental dysfunction, and any disability preventing active cooperation in study; (7) Patients who were presented with psychogenic nonepileptic seizures (PNES) alone; (8) Children with more than 10 seizures in 3 months.

Data extraction and outcome measures

Abstracted data and study quality were evaluated by two reviewers using a standardized extraction form. The reviewers resolved discrepancies by discussing and involving an additional author who referred to the original article until all the reviewers reached a consensus. The abstracted items included the author's name, published year, country's originated, design study, participants (who are based on age group, gender, and inclusion criteria), treatment (intervention, period and duration of intervention, follow-up time), Comparison/control (sham yoga and without any treatment), Outcome (based on Seizure frequency at 3 and 6 months follow-up), the measure of effect (number and percentage of seizure frequency), and the result. Reviewers tried to evaluate the quality of the

included studies using the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions.

Assessment of bias risks and methodological quality of included studies

Reviewers assessed the risk of bias and methodological quality of the included studies using the Cochrane Handbook for Systematic Reviews of Interventions tool for assessing the risk of bias in randomized trials. This tool evaluates vital domains such as Random sequence generation, allocation concealment, blinding of participants and staff, blinding of the assessment of results, incomplete result data, and selective result reports. To ensure accuracy and consistency in the results of each trial, the two reviewers will work collaboratively and come to a consensus. In the event of any possible inconsistencies, they will be addressed through open discussion or by seeking the evaluation of a third reviewer.

RESULT AND DISCUSSION

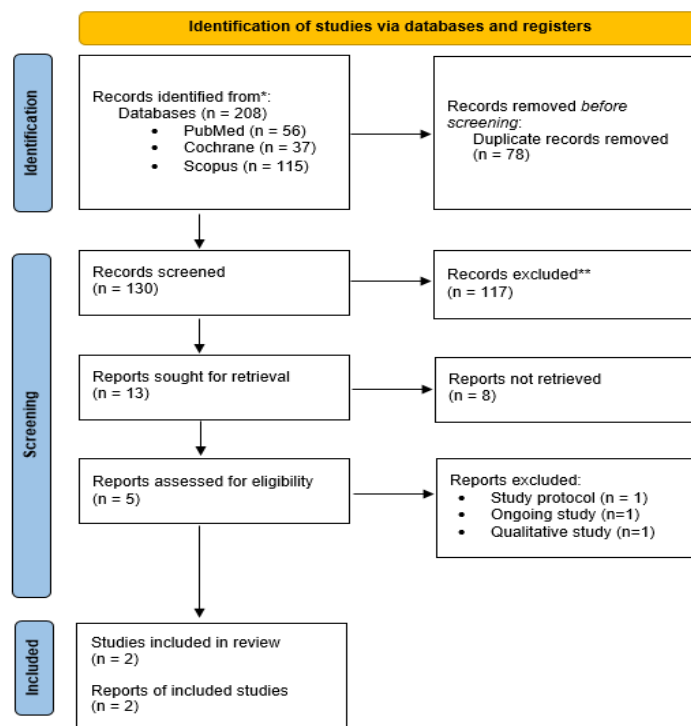


Figure 1 PRISMA flowchart of systematic review selection

We have found five studies in the last ten years that investigate or discuss the effects of yoga on patients with epilepsy. However, three out of the five studies need to be excluded from this review article because one study is the study protocol (Aktar et al., 2023), one study is a qualitative study of Palestinians using interviews (Shawahna & Abdelhaq, 2020), and another one is still ongoing (Krull, 2020).

Table 1 Characteristics of included studies

Author, Year	Design Study	Participant			Treatment			
		Inclusion Criteria	Sample Size, N (Male/Female)	Age (Years)	Intervention	Duration	Follow up	Control
Kaur, <i>et al.</i> , 2023	RCT	Adults with epilepsy who scored ≥ 4 on the Kilifi Stigma Scale (KSS).	160, 65 (104/56); intervention group (n = 80), control group (n = 80)	18-60	Yoga and psycho-education (3 months)	Group: 7 supervised group sessions, lasting about 45–60 minutes over 12 weeks (3 months). Individual: 30 minutes, at least five times a week at home.	We assessed at baseline, three months, and six months.	Sham yoga and psycho-education
Kanhere, <i>et al.</i> , 2018	RCT	Children with an established diagnosis of epilepsy, based on the International League Against Epilepsy (ILAE) definition, take AEDs regularly.	20 (15/5); intervention group (n=10), control group (n=10)	8-12	Yoga (2 months) and booster at the end of the fourth and fifth month)	Ten sessions, 1 hour each. Once a week over eight weeks (2 months), followed by two booster sessions at the end of the fourth and fifth month	Assessed at baseline, three months, and six months.	Without any treatment

Abbreviations: RCT = Randomized Controlled Trial; AED = Anti-Epileptic Drugs.

Two studies above assessed the effects of yoga on patients with epilepsy in different respondent characteristics, one on adult patients and another one on children. Those studies were conducted in India, which is the same country. The participants were randomized into intervention and control groups using a computer-generated randomization technique. Kaur *et al.*, 2023 created a computer-generated randomization list using the block permutation method stratified by seizure frequency. Then, sealed envelopes containing randomization codes were prepared by an independent researcher who was not affiliated with the study. Kanhere *et al.*, 2018 conducted randomization using computerized randomization tables. A detailed seizure history, along with background data, was also documented.

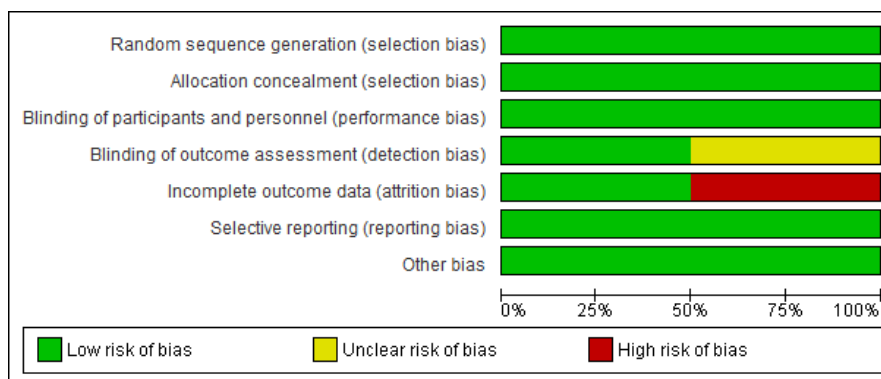


Figure 2 Graph of the risk of bias analysis performed as percentages across all the included studies

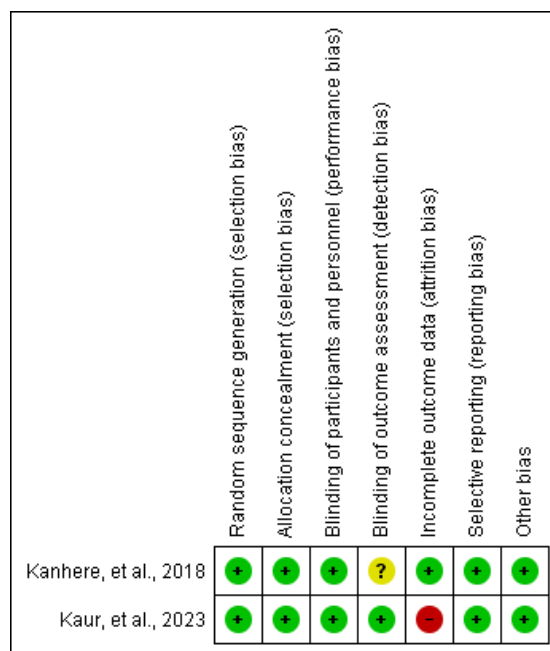


Figure 3 Summary of the risk of bias analysis for each included study

The quality of each included study has been assessed by Cochrane’s RoB 2, and the results are performed in **Figure 2** and **Figure 3**. The reason for the unclear risk of bias assessment on blinding of outcome assessment domain of Kanhere et al., 2018 is that there needs to be an explanation for the concealment of the assessor when assessing the outcome of the study. This is different from the high risk of incomplete outcome data domain in Kaur et al., 2023 because 25 out of 160 participants needed to follow the study completely, or it could be said that they were lost to follow-up.

We give the low risk in the blinding of participants domain in both studies even though they did not blind the participants in their study. The reason is that blinding in each study was difficult and not possible. The participants will surely know and feel the intervention given to them. However, blinding was applied in the allocation of participants into the research group.

Table 2 Seizure outcome summary of the included studies

Author, Year	Outcome	Result
Kaur, et al., 2023	Number of participants who have >50% seizure reduction and complete seizure remission	The proportion of patients who had >50% or 100% (complete seizure freedom) seizure reduction in the 3-month and 6-month follow-up was more significant in the yoga group than in the control group.
Kanhere, et al., 2018	Number of children with seizures at 3rd and sixth month	In the yoga group, no children had seizures at the end of 3 and 6 months. Whereas there were four and three children who had seizures at the end of 3 and 6 months, respectively, in the control group.

All types of seizure are reported in the included studies. Absence seizure is excluded in Kanhere, et al., 2018 study. Both studies showed that yoga as complementary treatment is able to reduce seizure frequency and duration in patients with epilepsy. Nevertheless, the result was insignificant statistically. It happened due to the high variability in seizure frequency per week at baseline (Kaur et al., 2023) and the patient’s effect of taking AEDs (Anti-Epileptic Drugs) (Kanhere et al., 2018). The outcome measurement used in Kaur, et al., 2023 was almost the same as the

outcome measurement used for analyzing the study's result in a Cochrane Review that consisted of the number of participants who had more than 50% reduction in seizure frequency and seizure-free status and the number of seizures per month to see the reduction in seizure frequency (Panebianco et al., 2017). The measure of more than 50% seizure reduction has been mandated by the European Medicines Agency for regulatory approval of novel pharmaceuticals for epilepsy (Kaur et al., 2023).

Protocols of Yoga

Yoga intervention should be conducted by a qualified physiotherapist who is a certified yoga instructor. Yoga instructions are given to the patients and their caregivers in the vernacular (Hindi) or English in an easy-to-understand manner (Kaur et al., 2023). The participants should have sufficient motivation and time to learn yoga and practice it daily according to the protocol.

The protocol of yoga as an intervention applied in each previous study differs. The components in sham yoga used by Kaur et al., 2023 include relaxation or loosening practice (*Sukshma Vyayama*), meditation, and positive affirmations or suggestions. The protocol included exercises that imitated the yoga poses described earlier, but the participants did not receive guidance on two essential aspects of yoga: (1) deliberate and coordinated breathing and (2) focus on body movements and sensations during the session. Without these two elements, the imitation intervention was expected to have a metabolic profile similar to that of yoga, yet lacked its fundamental elements that are believed to trigger a relaxation response. The step-by-step intervention protocol used for a patient in the sham group is *Sukshma Vyayama* (5 minutes, 5 rounds each) - Loosening of fingers, wrists, elbow, shoulder rotation, neck bending, toe bending without speed regulation, focus, and breathe. Breathing normally in a relaxed position for 10 minutes, and finally lying down in a relaxed position for 15 minutes.

On the other hand, Kanhere, et al., 2018 used a standard 10 hours yoga protocol that was designed by yoga experts and yoga teachers. The point is they applied the same yoga techniques, like controlled deep breathing patterns (*Pranayama*), relaxation or loosening practice (*Sukshma Vyayama*), meditation, and positive affirmations or suggestions. There are also other techniques of yoga that are applied in Kanhere, et al., 2018 such as specific physical posture control (*Asanas*), body balance and neuromuscular coordinating exercises, and games of body-mind coordination. Participants in a qualitative study from Palestine also use breathing, physical strengthening exercises, meditation, prayers, and spirituality (Shawahna & Abdelhaq, 2020).

There are different intervention characteristics based on frequency and duration of intervention. Besides the differences of such criteria that have been mentioned in the included studies (see **Table 1**), the study protocol states that each yoga session will last approximately 45-60 minutes three times per week for 8 weeks, the detailed instructions regarding the yoga session and procedures will be given by yoga instructor in the first session (Aktar et al., 2023). In addition, there is a qualitative study of Palestinians whose participants had been practicing yoga for years, ranging from less than 3 years to more than 5 years (Shawahna & Abdelhaq, 2020). Half of the participants practiced yoga in less than 30 minutes, and the rest were over 30 minutes. Most participants had one to three sessions of yoga per week. Based on the result of this study, one of the perceived benefits of yoga is improvements in the management of seizures.

Study Limitations

This review may still be insufficient to be generalized because the number of included studies according to the eligibility criteria is very limited. Moreover, the number of studies that investigate the yoga's effect on epilepsy is limited too, especially in pediatric patients. There are some

heterogeneities in the included study; such as the age group criteria and characteristics of the intervention (such as procedure, frequency, and duration of yoga). Therefore, a meta-analysis of the evidence base is impossible to be conducted.

CONCLUSION

The studies reported that yoga can reduce the frequency and duration of seizures in patients with epilepsy, both in children and adults. Furthermore, there were no reports of adverse effects of yoga as observed in the studies. Yoga has a good effect on body physiology, psychology, and the autonomic system. These effects apply to patients with epilepsy who are either taking AEDs regularly or getting drug refractory. A professional yoga therapist is needed to help practitioners practice yoga in order to reach optimal results. However, this review has not yet drawn a full and mature conclusion regarding the effectiveness of yoga as an additional treatment for epilepsy in adults and children because of the shortcomings of this review that has been explained at study limitations section. A multicenter, cross-cultural, well-randomized controlled study is proposed to be conducted. It may be done by recruiting a sufficient number of patients, using appropriate research methods, and defining explicit inclusion and exclusion criteria. Thus, it is expected to help reinforce the evidence of yoga's effect in controlling seizures of epilepsy and will probably be highly recommended as an additional therapy in epilepsy in the future.

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