

## “Impact of Physical activity on Epilepsy: A Review”

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### Abstract

Epilepsy has neurobiological, cognitive, psychological, and social effects that make individuals more secluded and suffer from increased social stigma. In order to increase quality of life in epilepsy, efforts should not only target seizure control but also consider all facets of life, such as physical and mental wellness. It's noteworthy that neither epilepsy patients nor medical doctors typically involve physical exercise programs. This resistance could be brought on by concern that exercise will trigger seizures, stigma, or misinformation. With the rise in data on the advantageous effects of physical activity (PA) on management of epilepsy and enhancing life quality, it makes sense to incorporate exercise programs as an additional non-pharmacological treatment for epilepsy. The major point is to support the potential application of an exercise regimen to either prevent or treat epilepsy. As a result, future studies are essential to study the advantages and impact of PA on epileptic patients. The current review of the literature includes 12 articles from the years 2017 to 2022 that were found by searching the PubMed and Google Scholar databases using keywords like "exercise," "epilepsy," "physical activity," "human treated for epilepsy," and "seizure physical training." These articles examine the most recent research on the risks and advantages of PA in epilepsy patients and indicate that being active has positive psychological effects on both social and mental health. However, in light of the information that is currently available, it is recommended that PA should be considered in epilepsy patients in order to boost life quality and overall well-being.

**Keywords:** Epilepsy, physical activity, seizure, exercise, quality of life.

### Introduction

The characteristic of epilepsy is a persistent tendency to cause seizures. Due to its neurological, cognitive, and psychosocial effects, associated stigma and withdrawal have increased. Epilepsy, according to the International League Against Epilepsy, is a condition marked by recurrent seizures that are not directly connected to a known cause.<sup>[1-4]</sup> The population of epileptics worldwide is around 50 million. 80% of epileptics, according to the World Health Organization (WHO), live in underdeveloped nations.<sup>[1,2-7]</sup> About one-fifth of all patients in India are suffering from epilepsy. In our demographic, it affects roughly 1% of people. This disease is present in about 45.9 million people worldwide and affects 12 million people in India, with socioeconomically disadvantaged groups and rural areas having greater prevalences.<sup>[8]</sup>

In general, high rates of depression and anxiety as well as psychosocial impairment have a close correlation with epilepsy. Given the intricate interactions between seizures, stigma and comorbidities it is therefore not surprising that some of these people have inadequate quality of life (QOL). In order to increase QOL, efforts should be made to consider all facets of life, such as mental and physical wellness.<sup>[9]</sup> It is noteworthy that neither epilepsy patients nor medical doctors typically involve physical exercise programs. This resistance could be brought on by concern that exercise will trigger seizures, stigma, or misinformation. With the rise in data on the advantageous effects of physical activity (PA) on management of epilepsy and enhancing life quality, it makes sense to incorporate exercise programs as an

additional non-pharmacological treatment for epilepsy.<sup>[10]</sup>

The benefits of PA for epileptics are generally the same as for healthy people, including increased work capacity, increased maximum aerobic capacity, reduced heart rate on sub-maximal standardized work level, weight loss, and decreased risk factors for diseases like diabetes, coronary heart disease, hypertension, osteoarthritis, and obesity.<sup>[11-13]</sup> The results of this topic's research indicate that being active has positive psychological effects on both social and mental health.<sup>[14,15]</sup> Young children that engage in physical exercise create neural reserves and upregulate neurotrophic factors, which may protect against the later onset of epilepsy. Brain-derived neurotrophic factor is a crucial modulator of effective synapses, neural connection, and plasticity in the hippocampus, cerebellum, and cerebral cortex. It also enhances the survival and proliferation of glutamatergic neurons. Exercise also causes the hippocampus to produce additional trophic factors, such as nerve growth factor and fibroblast growth factor 2.<sup>[11-13]</sup> People with epilepsy have been discouraged from participating in physical activities, despite research showing beneficial physical and psychological effects. There is a generalized anxiety of causing damage or triggering epileptic episodes.<sup>[14]</sup> Less research has been done on the efficacy of PA on epilepsy, despite the fact that it is beneficial. As a result,

the review focuses on how physical activity affects people with epilepsy and to observe its effect on fitness levels, psycho-affective functions, neuro-cognitive outcomes, delaying of seizures, and quality of life.

### Methodology

#### Search strategy

Search methodology involved searching of PubMed and Google scholar databases for articles that were published between 2017 to 2022. The keywords that were used to search the articles included the terms "epilepsy," "physical activity," "exercise," "human treated for epilepsy," and "seizure physical training." The inclusion criteria consisted of articles with full text availability, articles giving information regarding impact of physical activity on epilepsy and quality of life, articles in English language consisting of original articles, review articles, and randomised controlled trials. Whereas, the articles not providing brief description regarding impact of physical activity on epilepsy and quality of life, articles that were not published in English language, non-availability of full text, case reports, editorials, synopsis, insufficient data, and articles published before 2017 were excluded from the study. A total of 12 articles were included in this review based on the inclusion and exclusion criteria. Figure 1 illustrates the flowchart of the search strategy.

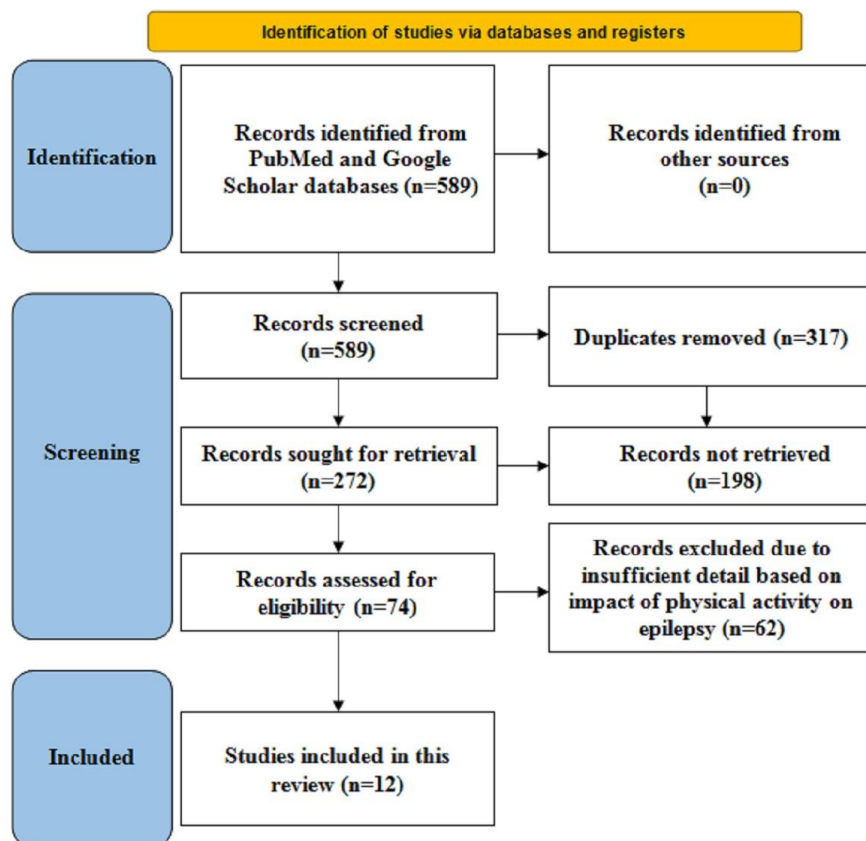


Figure 1: Search strategy for articles included in the review

**Data extraction**

Data from the 12 articles consisting of title and type of article, author and year of publication, protocol and

outcome, and main findings or conclusion was extracted and included in this review as shown in Table 1.

Sr No.	Title and Type of Article	Author and Year	Method and Result	Knowledge aspect of studies
1	Epilepsy and Physical Activity in US Adults.  Original article	Churilla et al. (2020) <sup>[16]</sup>	Data from the National Health Interview Survey cycles of 2010, 2013, and 2015 were included to evaluate the incidence and likelihood of meeting the 2018 PA recommendations using a nationwide sample of US individuals. Estimates were generated using logistic regression and descriptive analysis.	-Adults having epilepsy or a seizure disorder suggest that they are capable of engaging in both recreational PA and activity related to the strengthening of muscles. -However the probabilities of engagement was low.
2	Effects of physical exercise in people with epilepsy: A systematic review and meta-analysis.	Duñabeitia et al. (2022) <sup>[17]</sup>	Four electronic databases that contained information on the impact of PA training programs in epilepsy patients were looked up from their commencement until April 2022. For before-after studies with no control group scales, the quality assessment tool was employed, and the MINORS and PEDro scales were used to assess the methodological quality of the investigations.	-Exercise training in epilepsy patients can improve QOL, neurocognitive outcomes, fitness level, and psycho-affective results. -Overall, the results imply that exercising can help those who have epilepsy.
3	Physical activity, stigma, and quality of life in patients with epilepsy.  Original article	Tedrus et al. (2017) <sup>[18]</sup>	IPAQ score, SSE, and QOLIE-31, were all studied in connection to each other.	-The majority of epilepsy patients are inactive and avoid PA out of concern for seizures. -A lower PA is linked to depressive disorders, a lower QOL, and a higher stigma perception.
4	Impact of exercise as a complementary management strategy in people with epilepsy: A randomized controlled trial  Randomised Control Trial	Kumar et al. (2022) <sup>[19]</sup>	In this RCT with a masked end measure, smartphone-using epilepsy patients aged 18 to 65 were randomly split into two groups. The exercising arm was encouraged to get involved for 150 minutes per week of aerobic activity performed with moderate intensity, as advised by the most recent WHO standards, in addition to getting conventional treatment. QOL and PA were measured using the version 2 of GPAQ at baseline and after 12 weeks. Pedometer Step Counter, a smartphone app for tracking daily activity, was also	-Despite a rise in the PA correlations over when compared to baseline measures, there was no relevant difference found statistically between the groups. -Nonetheless, the exercise group's intra group analysis of the energy/fatigue measure revealed a substantial change.

			used to measure QOL. Moreover, scores for stigma, BMI, and seizure frequency were kept.	
5	The Feasibility and Impact of the EMOVE Intervention on Self-efficacy and Outcome Expectations for Exercise in Epilepsy.  Original Article	Dustin et al. (2019) <sup>[20]</sup>	For 30 outpatients, data were gathered at the start of the treatment and 12 weeks thereafter. Results for participants included the QOLIE-31, Beck Depression Inventory-II, exercise's self-efficacy and expected results in epilepsy, seizure frequency, average daily steps, and BMI. An activity monitor worn on the wrist was used to calculate the daily step count. Using treatment fidelity evidence, such as intervention delivery, receipt, and execution, the validity of the data was assessed.	-Participants reported lessened depression symptoms. - Enhancing physical performance using group or individualized exercise programs might improve depression.
6	Physical fitness levels and moderators in people with epilepsy: A systematic review and meta-analysis.  Review Article	Vancampfort et al. (2019) <sup>[21]</sup>	We thoroughly searched the major electronic databases for literature describing CRF reported as highest or peak oxygen absorption (ml/min/kg). The pooled mean CRF was calculated using a random effects meta-analysis that also included subgroup- and meta-regression analyses.	-Maximal test results showed considerably lower cardiorespiratory levels of fitness than submaximal test results. - The root reasons of CRF deficiency in epileptic patients could be concentrated.
7	How do you exercise with epilepsy? Insights into the barriers and adaptations to successfully exercise with epilepsy.  Original Article	Collard et al. (2017) <sup>[22]</sup>	There were three focus groups and three semi-structured interviews (11 participants total). The study's design and data analysis employed constructive grounded theory, which provided fresh perspective on exercise perceived barriers, motivation, and adaption strategies.	-According to this exploratory investigation, mixed exercise advice for epilepsy patients still exists. -Examining the most recent exercise recommendations given to the patients by healthcare providers requires more research. More medical professionals may become aware of the advantages of exercise for

				epilepsy and the existing recommendations as a result of this research.
8	Role of Physical Activity and Exercise in Alleviating Cognitive Impairment in People With Epilepsy. Rapid Review	Allendorfer et al. (2017) <sup>[23]</sup>	The purpose of this article was to highlight relevant findings from experimental models of epilepsy and to evaluate how increased PA leads to decreasing symptoms of depression, lowering seizure frequency, and decreasing epileptiform discharges that have been described as improving cognition in epilepsy.	-The efficacy of PA and exercise in reducing cognitive impairment in epilepsy was evident. -The lower PA in epilepsy may act as obstacles to overcome the limitation.
9	Exercise-linked consequences on epilepsy. Review Article	Cavalcante et al. (2021) <sup>[24]</sup>	We conducted a thorough literature search and talked about how PA affects epilepsy. Both Scopus and PubMed were searched and articles with pertinent data were included. Research articles written in English were only considered.	-The utilization of PA is a choice of therapy for epilepsy without consumption of medications.
10	Youth with epilepsy: Their insight into participating in enhanced physical activity study. Original Article	Willis et al. (2018) <sup>[25]</sup>	To investigate the efficacy of improved PA in young epilepsy patients, data were collected with RCT intervention group through interviews that are semi-structured. A tracker for activity was used for epilepsy patients for a year and got counseling by telephone conversations for the initial six months to help them attain a step goal, which was then continued by the Epilepsy patients for maintaining it for the subsequent six months. ICF was used to code the data throughout data collection and analysis, which was done within the context of phenomenological research. This was done in order to document all pertinent interventional effects.	-For coding qualitative data, the ICF system proved to be largely beneficial and efficient. -The precise and concise evaluation of limitation with ICF may help in developing patient oriented exercise regimen.
11	Physical and mental health comorbidities of patients with epilepsy in Germany - A retrospective cohort study. Original Article	Uepping et al. (2021) <sup>[26]</sup>	The adult participants had an epilepsy diagnosis between January 2018 and December 2018. By age, sex, and physicians, patients with and without epilepsy were matched one to one. The study's findings comprised multi-morbidity, which is defined as having at least two, three, four, or five separate diagnoses, as well as connections between epilepsy and various psychological and medical diseases recorded within 365 days of the index date. All study diseases were employed as dependent variables in the current study, while epilepsy was used as an impact variable.	-Comorbidities are more prevalent among people with epilepsy as they get older. -Senile comorbid changes could be dealt with improved PA.

12	Epilepsy, Physical Activity and Sports: A Narrative Review. Review Article	Carrizosa-Moog et al.(2018) [27]	This study examines the most recent research on the advantages and disadvantages of PA in this patient population. Several articles from the past 10 years point to notable improvements in mental and physical health indicators, such as physical fitness, QOL, social interaction, mood, cognition, and perhaps seizure onset preventative measures. Moreover, research suggests that PA has neurological protective mechanisms connected to structural and biochemical changes, such as the emission of steroids and $\beta$ -endorphins, which may have a suppressive influence on the emergence of aberrant electrical activity.	-PA has been shown to diminish or eliminate epileptic neurotransmitter discharges, which may result in fewer seizures occurring again. -Exercise has the potential to cause seizures in some individuals. -PA must be encouraged in order to improve patients wellbeing and QOL.
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Table 1: Literature review of the studies.

PA = Physical Activity, US = Unites States, MINORS = Methodological Index for Non-randomized Studies, PEDro = Physiotherapy Evidence Database, QOL = Quality of Life, IPAQ = International Physical Activity Questionnaire, SSE = Epilepsy Stigma Scale, QOLIE-31 = Quality of Life in Epilepsy, RCT = Randomized Controlled Trial,

GPAQ = Global Physical Activity Questionnaire, WHO = World Health Organization, BMI = Body Mass Index, CRF = Cardiorespiratory Fitness, ICF = International classification of functioning, disability, and health, EMOVE = Epilepsy-Motivate and outcome expectations for vigorous exercise.

The clinical trajectory of the studies is illustrated in Figure 2.

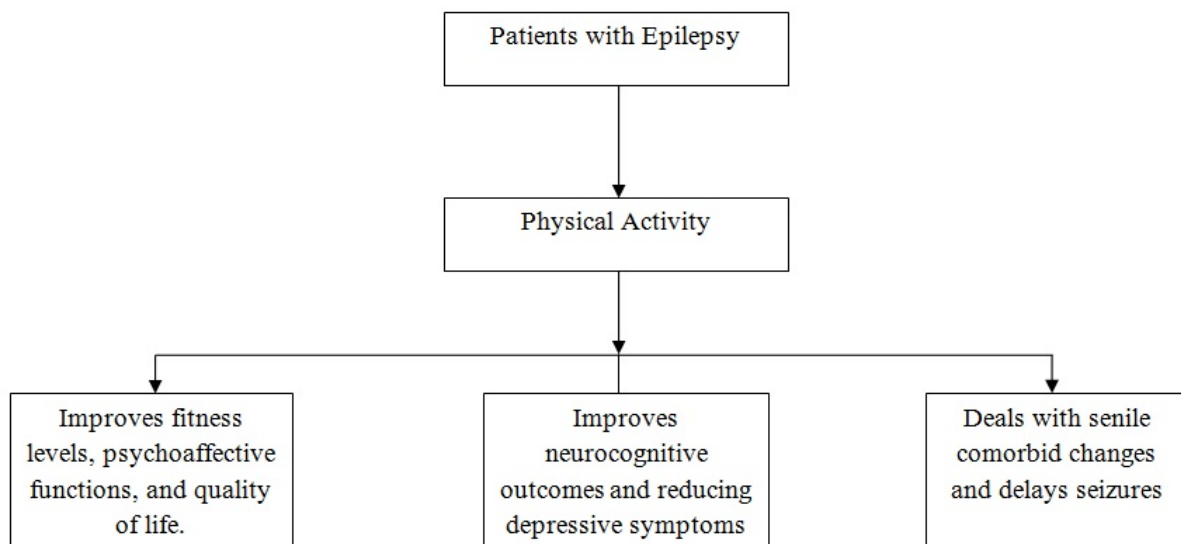


Figure 2: Clinical trajectory.

**Discussion**

The main aim of this review was to assemble the most recent data on the effectiveness of physical therapy or an exercise program for epileptic patients. The findings imply that physiotherapeutic therapies are advantageous and reliable for epileptics. According to the literature, there is a low risk of harm related with better seizure

control, psychosocial benefits, and improvements on comorbidities. Following a thorough physical exam that takes into consideration seizure control during the previous year, exercise programs should be encouraged. But in all the studies, the decision to use physiotherapy intervention was relatively discretionary. This review

of literature includes 12 research articles that discuss the effectiveness of PA for people with epilepsy.

According to Arida et al., 2008 year doctors must boost epilepsy patients to engage in PA on a daily basis to enhance self-esteem, overall fitness and social integration. To do this, they must have a thorough understanding of the patient's medical history, including any accidents brought on by seizures, seizure-free bouts, and adherence to medication.<sup>[28]</sup> Additionally, Tedrus et al. (2017) found that a large proportion of epilepsy patients are sedentary and avoid PA out of fear of seizures. The clinical aspects of epilepsy also have a negative impact on the willingness to engage in PA, hence, less PA is associated with decreased QOL and increased stigma perception. However, their study took into account a fairly limited sample size as well as the lack of generalized epilepsies among the samples gathered. Additionally, since only one region was studied, cross-cultural analyses are not feasible.<sup>[18]</sup>

Similar to this, Dustin et al., 2019 demonstrated the viability of the EMOVE strategy. Depressive symptoms considerably decreased during participation in the study. The study was limited by self-reported data and small samples but it nevertheless clearly demonstrates the urgent need to improve exercise routines in a group of patients who are typically disregarded. The intervention is practical in that it can be simply implemented into a routine clinical appointment. In order to more thoroughly analyze the relationship between the treatment and decreased depressive disorders, future studies should focus on boosting PA by individual or group exercise sessions and integrating a control group. It should also emphasize getting these patients to exercise regularly in order to significantly affect health outcomes.<sup>[20]</sup>

Vancampfort (2019) showed that maximal testing methods, such as treadmill and cycle ergometry tests, predicted lower CRF levels than submaximal methods. Further future studies should therefore investigate whether avoiding potentially anxiogenic activities is associated with a reduction in CRF in epileptics. Additionally, more studies are needed to investigate CRF levels in patients with different forms of epilepsy, and more research is necessary to comprehend how diverse forms of epilepsy are impacted by PA.<sup>[21]</sup>

According to a study by Collard et al. (2017) exercise is crucial for many epilepsy patients, and their own efforts to preserve physical and mental health have led them to develop self-management approaches. It is necessary to do more study with a larger sample size and a more diverse range of epilepsy patients to evaluate the present exercise recommendations made by healthcare experts to the patients. Due to a lack of diversity, a lack of socioeconomic data, and a majority of female participants relative to male participants, the demographics of the participants must also be considered. Additionally, the fact that the researcher

suffered epilepsy herself can be viewed as both a benefit and a potential roadblock to the study.<sup>[22]</sup>

For present state of PA in epilepsy the records suggests that epilepsy patients engage less in PA and maintain more sedentary lifestyle.<sup>[29,30]</sup> Consequently, a study given by Wrong et al. concluded that adolescents with epilepsy were obese and overweight and less involved in sports and in comparison to their siblings who were without the disease.<sup>[31]</sup> The possible causes include lack of time, exhaustion, the absence of company, and the fear and embarrassment of having a seizure in public.<sup>[32]</sup> According to a previous study, doctors, teachers, and instructors suggested epilepsy patients to avoid sports.<sup>[33]</sup>

Epilepsy patients prefer a sedentary lifestyle rather than engaging into physical activity leading to obesity and being overweight in these patients. The various limiting factors involved were lack of time, fear of having seizures in public, and exhaustion. Additionally, doctors, teachers, and instructors suggested to avoid sports.

Clinical aspects of PA in patients with epilepsy confirmed positive effects in people with epilepsy demonstrating a reduction in negative symptoms and a delay in the onset of epilepsy that were linked to the generation of galanin, which has antidepressant and anticonvulsant properties.<sup>[34,35]</sup> Additionally, PA can have a positive impact on chronic diseases such as asthma, diabetes, hypertension, and arthritis.<sup>[36,37]</sup> Physical inactivity has been linked to a higher chance of developing anxiety and depression.<sup>[38]</sup> Similarly, a study reported that practising PA on regular basis can result in decreased depression levels.<sup>[39]</sup> Additionally, PA leads to have positive impact on psychosocial function, neurocognitive domains, and quality of life.<sup>[40]</sup>

PA reduces negative symptoms such as depression and delays onset of seizures. PA also has positive effects on other chronic diseases such as asthma, diabetes, hypertension, and arthritis. It had beneficial effects on psychosocial function leading to improved quality of life.

From opioid system discharge of  $\beta$ -endorphins, the discharge of steroids as a result of stress, an increase in melatonin concentrations, and an increase in parvo albumin in afflicted cells which has been associated with cytoprotection, anti-epileptogenic effects, and prevention of neuronal death following seizures, and reduction of hyper-reactivity of CA1 cells and the hippocampus undergoes structural changes that may have an inhibitory effect on the occurrence of aberrant electrical discharges as part of the mechanism by which PA improves seizure control.<sup>[41-45]</sup> The inhibitory action of nor-adrenaline and gamma-aminobutyric acid (GABA) released during exercise was considered to be responsible for the delay in seizure incidence.<sup>[36]</sup> Additionally, exercise reduced the generation of free

radicals and oxidants.<sup>[46]</sup> Animals participating in a PA regimen showed shorter seizure duration of lower intensity.<sup>[47]</sup> The probable explanations include enhanced angiogenesis, reduced excitotoxicity, expression of neuronal growth factors, and discharge of neuroprotective trophic factors.<sup>[48-51]</sup>

The nor-adrenaline and GABA released during exercise has inhibitory action which is responsible for delay in seizure as well as reduced intensity of the seizure may be brought about by a decrease in excitotoxicity, the release of neuroprotective trophic factors, an increase in angiogenesis, or the expression of neuronal growth factors.

Adverse effects of PA on epilepsy demonstrated that patients with epilepsy may have seizures which are exercise-induced.<sup>[30,52]</sup> The incidence of seizures caused due to PA is very rare and are mainly caused due to high-intensity exercises.<sup>[30,53]</sup> Furthermore, high altitude is also responsible for seizures due to hypoxia.<sup>[53]</sup> According to Arida et al. seizures caused due to PA are related to homeostatic changes consisting of hyperthermia, fatigue, hyperhydration, hyponatremia, hypoglycaemia, and hypoxia. Hyperventilation is known to regularly cause absence seizures along with focal seizures at rest in patients due to respiratory alkalosis. This explanation does not prove its justification as exercise results in metabolic acidosis.<sup>[54]</sup>

Adverse effects involve exercise-induced seizures which is very rare and is mainly caused by high-intensity exercises. Additionally, high altitude also plays an important role for seizures which are mainly caused due to hypoxia. At rest due to respiratory alkalosis hyperventilation causes absence seizures along with focal seizures whereas, exercise results in metabolic acidosis.

This review highlights the need for additional studies to fully grasp the distinct and variable effects of different PA types on elements like the suppression of seizure frequency, interictal epileptiform discharges (IEDs), and depressive symptoms that can impair functions related to cognition. Generally, the present research environment in this area is promising, and there is a need for epilepsy sufferers to participate in more exercise,

sport activities and recreational activities. In conclusion, even though PA and exercise may be a valid option for supplemental treatment to improve cognitive abilities, further RCTs are unquestionably required to produce more clinical evidence.

### Conclusion

Compared to the general population, epilepsy patients are less physically active. A few potential causes include intolerance, ignorance, overprotection, fear of starting seizures, stigma, and an absence of medical experience. This study covers the most recent research on the dangers and advantages of PA in this patient population. Indicators of physical and mental health, including mood, cognition, overall conditioning, social interaction, QOL and maybe seizure onset preventative measures, have improved noticeably over the previous ten years, according to a number of studies. Moreover, research suggests that PA has neurological protective mechanisms connected to structural and biochemical changes, such as the emission of steroids and  $\beta$ -endorphins, which may have a suppressive influence on the emergence of aberrant electrical activity. Exercise has been shown to diminish or eliminate epileptic discharges, which may result in fewer seizures occurring again. The research that is currently available indicates that PA should be supported in epilepsy patients to enhance welfare and quality of life. Before firm recommendations can be made, prospective randomized controlled studies that offer more robust clinical data are required.

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No financial support was provided to conduct this study

### Conflict of Interest

The authors do not have any competing interests.

### Author's Contribution

The final manuscript was reviewed and approved by all authors.

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