

Exercise and sports in patients with seizures and epilepsy. Literature review

Ejercicio físico y deportes en pacientes con crisis epilépticas y epilepsia. Revisión de literatura

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Abstract

Physical exercise and sports in healthy people are very important factors for physical and mental health; however, in patients with epilepsy, there are still questions for the beginning or continuity of their practice, becoming restricted in most cases. Therefore, it is necessary to have more information about the type of seizures, treatment, control and evolution of each patient, as well as the physical exercise and sports options that they can practice. The implementation of recommendations for the different cases of seizures/epilepsy and their association with physical exercise/sports is of great importance for the permissions or restrictions depend on each patient.

Keywords: Epilepsy. Epileptic seizures. Physical exercise. Sports. Physical activity.

Resumen

El ejercicio físico y los deportes en personas sanas son los factores muy importantes para la salud física y mental, sin embargo, en pacientes con epilepsia aún hay interrogantes para el inicio o continuidad de su práctica, llegando a restringirse en la mayoría de los casos, por lo que es necesario tener más información acerca de los tipos de crisis epilépticas, tratamiento, control y evolución de cada paciente, así como las opciones de ejercicio físico y deportes que pueden realizar. La implementación de recomendaciones para los diferentes casos de crisis epilépticas/epilepsia y su asociación con el ejercicio físico/deportes es de gran importancia, ya que las permisiones o restricciones dependen de cada paciente.

Palabras clave: Epilepsia. Crisis epilépticas. Ejercicio físico. Deportes. Actividad física.

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Introduction

Epilepsy is a chronic neurological disease that affects people of all ages. It is responsible for a significant proportion of the global burden of disease, affecting more than 50 million people¹. Various studies have shown that patients with epilepsy (PWE) report their health as poor and that they exercise less compared to the population that does not suffer from epilepsy^{2,3}. The most frequent reason for physical inactivity is the disease itself. A large percentage of patients have never talked to their doctors about doing sports or their recommendations or having the false idea that physical exercise is harmful to PWE⁴⁻⁶.

As in healthy people, PWE can benefit from exercise by decreasing the percentage of body fat and metabolic and cardiovascular risk^{7,8}. In addition, clinical studies have reported the association of exercise with the reduction of epileptiform discharges in the electroencephalogram (EEG) and increase the seizure threshold, as well as improvement the quality of life and mental health⁹⁻¹³.

Exercise and epileptic seizures/epilepsy

Aerobic exercise

Aerobic exercise has been reported as a trigger for seizures; however, this has not have a significant impact, as patients are able to recognize this association and avoid activity if necessary^{5,6,14}.

In the absence seizures triggered by hyperventilation at rest, there are electroencephalographic changes, which are extrapolated to the fact that seizures could be triggered by hyperventilation induced by exercise. This is unlikely due to the physiological differences between resting and exercise-induced hyperventilation. In hyperventilation at rest, hypocapnia occurs, which produces cerebral vasoconstriction, promoting alkalosis, which can make electroencephalographic abnormalities more pronounced. In hyperventilation induced by exercise, there is an increase in metabolic demand, which is the cause of increased respiratory effort, which, in turn, is a compensatory response to avoid hypercapnia. Because the increased respiratory effort during exercise is a response to acidosis, it has the opposite effect of resting hyperventilation by causing relative suppression of EEG abnormalities. Exercise-induced hyperventilation can even produce a refractory period that can delay the activating effects of hyperventilation at rest^{10,11}.

Interictal epileptiform activity usually remains unchanged or may decrease during or immediately after exercise even in patients with exercise-related seizures⁹. There are several studies that report the reduction in seizure frequency with aerobic exercise^{7,8,15,16}.

A study was carried out in patients with temporal lobe epilepsy in which they practiced maximum/exhaustive physical exercise without the presence of seizures during or after exercise¹⁷.

Sports and epileptic seizures/epilepsy

Contact sports

The positions toward the participation of PWE in contact sports have changed over time. It has been thought that injuries from contact or sports collisions resulting in mild head injuries may worsen epilepsy; however, most of these risks are theoretical and very few case reports support this position. A more appropriate approach is to individualize the decision for each sport and patient based on a risk-benefit analysis, leading to few restrictions overall. Although it is possible that the presence of a seizure during certain athletic events could cause a substantial increase in risk to the patient, this is more related to sports such as gymnastics or horseback riding and contact sports such as football, hockey, and soccer induce seizures. In the case of boxing, studies in amateur boxers showed that concussions were mild and did not result in clinical or neurophysiological signs of epilepsy¹⁸⁻²⁰.

One of the arguments for not allowing participation in contact or collision sports is that the multiple mild head trauma associated with such participation could exacerbate seizures; however, there is little evidence for this and for most PWE not there is evidence that contact sports are harmful^{21,22}.

Although there is evidence that head trauma can cause epileptic seizures, this association is only valid for severe trauma^{19,23-25}. There are no consistent reports of an increased risk of epilepsy following mild head injury in the general population, typical sports-related injuries are so mild that they are highly unlikely to be associated with epilepsy¹⁸.

Exercise and metabolism of anti-seizure drugs (ASDs)

A special consideration in PWE is the effect that exercise has on antiseizure drugs (ASDs). Exercise induces the release of hepatic microsomal enzymes,

which may increase drug clearance. Additionally, the release of fatty acids can compete for protein-binding sites, displacing highly protein-bound drugs and increasing their free fraction. Therefore, close supervision is required to maintain treatment efficacy, and dose adjustments may be necessary as needed^{18,19,26,27}.

Risks and benefits associated with exercise

Risks

Based on prospective and retrospective studies, PWE and epileptic seizures have a higher risk of injury. The most common are mild head injuries, submersion injuries, burns, and fractures^{28,29}.

The risk of seizures and the association of injuries is higher in uncontrolled epilepsy, high seizure frequency, and with primarily or secondarily generalized seizures. In these cases, there is a greater risk of presenting seizures during activities of daily living or exercise, and the conclusion of multiple studies is that the most common injuries related to seizures are soft tissue injuries; therefore, it is important to know the type of crisis when exercise is recommended and the associated risks^{6,29}.

For high-risk sports, some authors prohibit their practice in the PWE; however, if patients decide to continue practicing them, the cases must be individualized based on the risk-benefit of each patient, for example, to perform diving in a review; it was concluded that although the risk of death is high, if there is freedom from seizures for at least 4 years, the risk of having a seizure during is minimal, due to the sedative effect of some ASDs, it is recommended not to dive as it increases the risk of nitrogenous narcosis. The UK Sports Committee recommends diving in patients with epilepsy with 5 years of seizure freedom and no treatment, in the event that seizures are exclusively nocturnal, this can be considered individually with the committee through the appeals process^{6,30-32}.

Benefits

In basic research, positive results have been obtained about physical exercise, it has been found that it can help reduce cell loss or neuronal damage secondary to brain lesions in animal studies^{6,33}. In animals with epilepsy induced with pilocarpine, penicillin, pentylenetetrazole, and kainic acid have had the same positive results in terms of the presence of a lower frequency of spontaneous seizures by carrying out a physical training program, as well as a low probability

of seizures induced by exercise, without the presence of sudden death during exercise. Even intense training improved seizure frequency^{6,15,33-40}.

Several studies report a decrease in the frequency of seizures when performing aerobic exercise or the absence of exercise as a seizure inducer. PWE who regularly exercise tend to report fewer seizures than sedentary patients, indicating that exercise may be a complementary therapy for patients with epilepsy^{7,17,41-44}.

Another of the benefits of exercise is that it helps prevent or treat comorbidities such as obesity by reducing the percentage of body fat, as well as cardiovascular and metabolic risk in patients with epilepsy^{8,30}.

The therapeutic effect of exercise on depression in patients with epilepsy has been studied with good results. Some explanations for this consist in the increase and regulation of neurotransmitter systems involved in the pathophysiology and improvement of other comorbidities that may influence depression. Patients with epilepsy who exercise present lower levels of depression regardless of other factors such as age, gender, seizure frequency, or stress^{16,28,41-45}.

Recommendations international league against epilepsy (ILAE)

In 2016, the ILAE published a general guide for participation in specific sports for patients with epileptic seizures and epilepsy, as well as recommendations for the issuance of medical certificates related to the practice of sports activities⁵.

Said guide lists the types of epileptic seizures, their temporality, severity, and their control with a classification of sports divided into three categories based on the potential risk of injury or death of patients with epilepsy or of the close people or bystanders due to the presence of a crisis (Table 1).

The sports classification is divided into:

- Group 1: without significant additional risk
- Group 2: moderate risk for PWE, but not for other people
- Group 3: high risk for PWE and in some sports also for other people.

Classification of epileptic seizures and recommendations according to sports groups:

- One or more acute symptomatic seizures: seizures related to a transient factor that temporarily lowers the seizure threshold in a normal brain (for example: in transient toxic, infectious, and metabolic processes) which does not allow the diagnosis of epilepsy, and the risk of future crises depends on the

Table 1. Sports suggestions for patients with seizures and/or epilepsy

Sports	One or more symptomatic attacks	Single unprovoked seizure	Seizure freedom (≥ 12 months)	Seizure related only to sleep	Seizure without loss of awareness	Seizure with loss of awareness	Resolved epilepsy (seizure-free > 10 years and ASDs-free > 5 years)	Medication withdrawal
Group 1* (no significant additional risk) Athletics (except those listed in group 2) Bowling/Contact sports (judo, wrestling, etc.)/Team sports (baseball, basketball, cricket, field hockey, soccer, rugby, volleyball, etc.)/Skiing cross country/Curlin/Dance/Golf/Racquet sports (squash, table tennis, tennis, etc.)	Permitted	Permitted	Permitted	Permitted	Permitted	Allowed at the discretion of the neurologist, applies when seizures are precipitated by specific activities	Permitted	Allowed at the discretion of the neurologist, applies when seizures are precipitated by specific activities
Group 2* (moderate risk for patients with epilepsy, but not for other people) Alpine skiing/ Archery/Athletics (pole vaulting)/Biathlon, triathlon, modern pentathlon/Canoeing/ Contact sports involving a potentially serious injury (for example: boxing, karate, etc.)/ Cycling/Fencing/Gymnastics/ Horse riding/Ice Hockey/ Shooting sports/ Skateboarding/Skating/ Snowboarding/Swimming/ Water Skiing/Weightlifting	Allowed at the discretion of the neurologist, with restrictions (see text)	Allowed after 12 months without seizures	Permitted	Allowed at the discretion of the neurologist, with restrictions (see text)	Allowed at the discretion of the neurologist, with restrictions (see text)	Allowed at the discretion of the neurologist, with restrictions (see text)	Permitted	Allowed after appropriate periods followed by withdrawal of anti-seizures medications (see text)
Group 3* (high risk for patients with epilepsy and in some sports also for other people) Aviation/Mountaineering/ Diving/Horse racing (competitive)/Motorized sports/Skydiving (and similar sports)/Rodeo/Diving/Ski jumping/Sailing (solo)/Surfing/ Windsurfing	Allowed at the discretion of the neurologist, with restrictions (see text)	Allowed after 12 months without seizures	Permitted	Generally prohibited, but may be considered, with neurologist's discretion, for sports that do not suppose any risk to other people (see text)	Generally prohibited, but may be considered, with neurologist's discretion, for sports that do not suppose any risk to other people (see text)	Generally prohibited, but may be considered, with neurologist's discretion, for sports that do not suppose any risk to other people (see text)	Permitted	Allowed after appropriate periods followed by withdrawal of anti-seizures medications (see text)

*The classification was made by consensus, taking into account the most common conditions that apply when patients with epilepsy practice these sports. Individual characteristics and circumstances should be evaluated to indicate a different classification, based on the physician's judgment. A sports for which the above permission may apply based on the neurologist's discretion. The latter includes, in addition to informed consent: evaluation of specific clinical aspects and risks related to the specific sporting activity, and feasibility of medical surveillance and appropriate supervision during the activity. For more detailed information.

(adapted from: Capovilla et al.²).

nature and evolution of the underlying condition causing the crises. Once the cause is resolved, the risk of future crises should generally be low unless there is a high probability of recurrence of the precipitating event.

- Group 1: if the risk is low
- Group 2 or 3: probably, at the discretion of the neurologist depending on the medical care and neurological advice of the recurrence risks of the causative event and through informed consent (signed by the parents of the children and adolescents, but with the participation of the minors for discussion and understanding of risks and benefits).
 - Single unprovoked seizure: associated with > 60% probability of recurrence within the next 10 years qualifies for a diagnosis of epilepsy.
- Group 1: either daytime or nocturnal onset, with appropriate neurological counseling.
- Group 2 or 3: after 12 months of seizure freedom, subject to appropriate neurological counseling, or immediately at the discretion of the neurologist with informed consent and under medical supervision, with supervision during the activity.
- Neurological discretion should take into account the prognostic factors for seizure recurrence, such as the presence or absence of structural brain lesions considered potentially seizure-generating.
 - Seizure free: after 12 months of freedom from crisis, they can practice all sports
 - Sleep-related seizures:
- Group 1: yes, immediately.
- Group 2: they can be considered to practice some sports (such as swimming or canoeing) at the discretion of the neurologist, informed consent and under medical surveillance, with supervision during the activity, or they can do all the sports in this group after 12 months of follow-up whether the frequency of seizures during this period is sufficient to confirm with certainty the exclusive association of seizures related to sleep and whether the sport does not involve significant alterations in the sleep-wake cycle.
- Group 3: contraindicated due to the possibility of harm to others; however, in sports in which only the patient may be injured, some may be considered at the discretion of the neurologist, with advice after 12 months of follow-up, as long as the seizure frequency is sufficient to confirm that the occurrence. It is exclusively related to sleep, with informed consent, medical surveillance, and supervision during the activity.

Seizures without loss of alertness:

- Group 1: yes, immediately.
- Group 2: some sports (such as swimming or canoeing) at the discretion of the neurologist, informed consent, medical surveillance, and supervision during the activity, or all sports can be performed after 12 months of follow-up, as long as their seizure frequency is sufficient to confirm the clinical semiology.
- Group 3: not for harm to others; however, in sports in which only the patient is likely to be injured, some of these sports may be considered at the discretion of the neurologist with in-depth counseling by the neurologist after 12 months of follow-up, as long as the frequency of seizures is sufficient to confirm ictal semiology, informed consent, medical surveillance, and supervision during the activity.

Seizures with loss of alertness: patients with uncontrolled seizures associated with altered alertness.

- Group 1: yes, unless the activity involves exposure to specific precipitating factors, as in the case of some reflex epilepsies.
- Group 2: yes, at the discretion of the neurologist, informed consent, medical surveillance, and supervision during the activity.
- Group 3: no, due to the risk of harm to others; however, in sports in which only the patient is likely to be injured, some of these sports may be considered with the consent and discretion of the neurologist under exceptional circumstances, for example, when medical surveillance is appropriate, there is supervision during activity, with neurological counseling allows to exclude an excessive risk of damage related to seizures.

Resolved epilepsy

According to the ILAE, when there is freedom from seizures, whether you have had an age-dependent epileptic syndrome but have passed the applicable age or have remained without seizures for the past 10 years and without antiepileptics for at least the past 5 years.

- Group 1, 2, 3: yes, you can do all sports.

Medication withdrawal

Patients should be informed that the reduction or withdrawal of ASDs involves a risk of seizure recurrence, which varies in relation to the type of epilepsy, the previous duration of seizure freedom, and other factors. Patients undergoing ASD reduction or withdrawal, neurologists, rehabilitation physicians, and

sports physicians need to consider individual risks of seizure recurrence when making decisions regarding practice and competition in specific sports.

According to the driving directive of the United States of America, patients with epilepsy who are seizure free:

- Group 2 or 3: no, at the beginning of the withdrawal period of ASDs and later for a period of 6 months after the cessation of treatment.
- Group 2 or 3: no, when patients had seizure recurrence during treatment change or ASD withdrawal, for a period of 3 months after the previous effective treatment is reinstated and without seizures during this period.

Conclusion

Exercise is a fundamental part of a good quality of life, which it is necessary to implement tools that help health professionals to advise on exercising and practicing sports in patients with epilepsy, since its performance may be a complementary therapeutic strategy in the treatment of epilepsy and its comorbidities^{5,46,47}.

Restrictions on exercise and sports in patients with epileptic seizures and epilepsy have been a constant due to the stigma of the condition itself, as well as the generalization of probable risks to all patients with such diagnoses.

Appropriate advice taking into account the type of epileptic seizures, the time of evolution, treatment, seizure control, and the type of physical exercise or sport to be practiced is the basis for achieving a good quality of life, reducing the risk of depression, as well as other metabolic and cardiovascular comorbidities.

Observational and controlled studies are still lacking for the different types of sports and epileptic seizures, which are why what is reflected in this review work are recommendations and suggestions from the mentioned authors. The recommendations issued by the ILAE are based on opinions and the driving regulations of the United States are used as the main reference^{5,48}.

It is extremely important to consider the individual conditions and risks of each patient, always under adequate supervision, since the success of the association of epileptic seizures/epilepsy and exercise/sports depends on it.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical considerations

Protection of humans and animals. The authors declare that no experiments involving humans or animals were conducted for this research.

Confidentiality, informed consent, and ethical approval. The study does not involve patient personal data nor requires ethical approval. The SAGER guidelines do not apply.

Declaration on the use of artificial intelligence. The authors declare that no generative artificial intelligence was used in the writing of this manuscript.

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