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Effect of selected aerobic exercise training on the occurrence of electroencephalographic disorders in epileptic children

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ABSTRACT

Introduction: Existent research indicates that physical activity can not only improve physical and mental status of epileptic patients, but can also reduce the frequency of seizures. Therefore, the present study seeks to determine the effect of physical activity on the occurrence of seizures during, immediately after and 24 hours after those exercises. It can, consequently, remove these patients' fear of seizures during and after physical exercises. Such fear naturally impedes engagement in physical activities. **Methodology:** This semi-experimental research was carried out on 10 general epileptic children whose age ranged between 8 to 14 years (mean=10 years old) and who were all male. The test was performed according to Nakkenet al.'s (1997) protocol designed as A-B-A. In stage A, the child would sit on a stationary bike with open eyes without making any movement. In stage B, the child would be pedaling for about 10 minutes before exhaustion. The work load would rise in accordance with the subject's potential heart beats. All throughout the test performance, an electroencephalographic device would record brain electric flows. **Results:** The patient experienced no seizure during the physical activity or after that. An insignificant increase was also observed in the recorded electric flows during the exercise compared to those recorded before the exercise. **Discussion:** Physical activity has no negative effect on the occurrence of seizure among epileptic children. These children can do physical exercises as normal children do.

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INTRODUCTION

Epilepsy is the second most prevalent neural disease (brain stroke being the first). It may last through one's whole life and requires regular care and attention [3]. Epilepsy is prevalent throughout the world. The factual prevalence of epilepsy is, on average, 3.8 cases per thousand people (1.5 to 20 cases per thousand people). Its prevalence is higher among children and the elderly [1]. According to the research conducted by Iran's central office of preventing the ministry of health, treatment and medical education's diseases, the prevalence of epilepsy in Iran was 2.12 per thousand people in 2004 [2].

Physical activity is essential and beneficial for all individuals. Doing physical exercises has considerable advantages such as treatment, prevention and reduction of pathogens [4].

Fear of seizures, an increase in their frequency, lack of adequate motivation and energy, lack of awareness or support from the side of medics, family or friends, fear of changing the healing effect of medication and insufficient sport facilities are among reasons why epileptic patients refrain from doing physical exercises [5]. However, those who managed to overcome such obstacles have been privileged with the benefits of sports. An extensive body of research with this regard has attested to these benefits. Physical exercises can not only improve physical and mental status of epileptic patients but can also be used as a complementary and non-medical treatment [4].

Heise (2002) investigated the effect of a 12-week aerobic exercise which was held 3 sessions a week each lasting for one hour (60% of VO2 peak) on 23 adult epileptic patients. Findings of this research revealed a significant rise in strength, endurance and VO2peak. It also indicated a reduction in the percentage of body fat among the subjects [6].

There are divergent views on the effect of physical exercises on the frequency of epileptic seizures. This matter is still controversial among patients and medics.

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Linux (1941) maintained that physical and mental activities might have anti-seizure effects. Seizures commonly occur once the individual is either resting or asleep [7]. Nakken (1997) observed a reduction of disorders in the electroencephalography of 20 out of 26 epileptic children. This reduction was, however, only significant in the group afflicted with focal epilepsy. Activity time and small sample size were among the limitations of this study. These could have contributed to the insignificance of results [8].

Furthermore, Camilo (2009) observed no seizures among epileptic patients during the activity and return to the initial stage of the biking test up until the exhaustion point. Small sample size along with unknown type and frequency of seizures led to the insignificance of these results [9].

Considering the limited body of research on sports and the occurrence of seizures during sports, the present study seeks to investigate the effect of selected aerobic exercises on the occurrence of electroencephalographic disorders among epileptic children.

Methodology:

The present research was of a semi-experimental type. 10 subjects were selected from among those who had consented to participate in the research project (and also met all required conditions). Inclusion criteria were: 1. 8-14 years of age, 2Having passed at least 1 year of established general epilepsy, 3. Having no kinetic limitation for doing physical activities, 4. taking anti-epileptic medication and all taking valproic sodium as a medication. At the outset of research, after submitting full consent for participation, the candidates were familiarized with the procedures and how they were to perform the exercises. Then, their height and weight indices were measured and recorded.

The overall design of this study is adopted from Nakken et al.'s (1997). Previous limitations were, however, made up for. 2.5 hours after the meal the subjects' brain electrical activity was recorded in three stages: 1. 10 minutes prior to the exercise, 2. 10 minutes on average during the exercise, 3. 10 minutes immediately after the exercise.

This protocol contained 3 movements: 1.Thisstage began with adjusting the leaning chair and fastening chest belt, wearing the polar watch and the electroencephalographic cap on the subject. Subsequently, his resting heart rate was measured which helped to estimate his maximum heart rate suited for the target age as well as heart rates at the intensities of 50-60-70-80-90% of patient's potential heart rate. All throughout the 10minutes before the beginning of physical activity, the subject was sitting in a relaxed way and without any movement. Meanwhile, the electroencephalography device was recording his brain activity. 2. In this stage, the patient began to pedal for 2 minutes as a warm-up with an intensity of 50% of potential heart rate. After 2 minutes of pedaling, he had to continue the same activity for 2 more minutes but at the intensity of 60% of potential heart rate. This process continued increasingly up until the subject reached the exhaustion limit. It needs to be noted that during the whole process brain activity was being recorded by the electroencephalography device while one's eyes were open. Once the subject reached the exhaustion point, the device began to record one's brain activity for 10 minutes of inactive rest.

Once the data were collected they were analyzed by SPSS version 11.5 which firstly labeled all the variables. Kolmogorov-Smirnov test was used to make sure of the normal distribution of the data. Repeated measure ANOVA was used in order to compare the variances (pre-exercise and post-exercise). In case significant results were obtained, post-hoc tests were used to determine the variance difference between the pre- and post-exercise tests. The significance level was set at $p<.05$ in order to test the hypotheses.

Results:

Among the subjects, no seizure occurred during the whole test (before the exercise, during the exercise, immediately after and 24 hours after the exercise). There was an increase in the mean epilepsy index as the measurement unit of electroencephalographic disorders during the exercise compared to the pre-exercise stage (table 1). This divergence (.373) was, however insignificant at the specified significance level ($p<.05$). The mean epilepsy index was reduced after the exercise was over as compared to during the physical exercise (table 2). This divergence was yet insignificant at $p<.05$ (.477).

Table 1: the mean epilepsy index before and during the exercise

	Mean	SD
Pre-exercise	75.600	69.26
During the exercise	89.600	57.19

Table 2: the mean epilepsy index during and after the exercise

	Mean	SD
During the exercise	89.600	57.19
Post- exercise	75.300	86.51

The mean epilepsy index was decreased after the exercise as compared to before the exercise. However, this divergence (.979) was not statistically significant ($p<.05$).

Table 3: the mean epilepsy index before and after the exercise

	Mean	SD
Pre-exercise	75.600	69.26
Post-exercise	75.300	86.51

Discussion:

The traditional and conservative outlook of some parents and medics plays a significant role in reducing epileptic children's engagement in physical exercises. This has led them to live an inactive lifestyle. Such inactivity would, in turn, lead to the lowering of physical fitness and therefore gaining weight as compared to normal children [8,9]. A number of studies have investigated the correlation of sportive exercises and the frequency of seizures. Their findings were indicative of the non-occurrence of seizures which is similar to the findings of the present research [6,9]. All the research on animals carried out by Arida indicated a reduction in the frequency of seizures or even the non-occurrence of seizures among these animals [10,11].

EEG disorders are reported as an increase in neuroplasticity and can result in clinical seizure. According to the research findings, epileptic disorders during the exercises were increased as compared to the pre-exercise stage. This divergence was, however, insignificant.

Nevertheless, in a similar research Nakken [6] observed a reduction of disorders among children afflicted with focal and general epilepsy. Among general epileptic children this reduction was not significant due to the small sample size. In addition, Kotz [65] and Harvard [56] indicated that doing physical exercises up until the exhaustion limit has a natural and normal effect on EEG. They, therefore, suggested that this reduction could be due to the increase in GABA concentration and lead to metabolic acidosis. However, no mention was made of the type of epilepsy the participants of these studies suffered from.

Sportive mechanisms influencing the reduction of epileptic seizures are not precisely known yet.Kotz… et al. (1967) maintained that the reduction of PH as a result of acidosis would lower the stimulation of cortex, while an increase in PH would add to that stimulation [12]. To the contrary, some believe that doing sportive exercises does not influence PH as much as is required to affect electrical activity. They believe that beta-endorphins intervening in the electric activity are the reason why epileptic seizures are reduced [4,9]. Finally, brain alertness and wakefulness during physical exercises is effective in cutting down on epileptic seizures [12].

As concerns the increase in EEG disorders in patients after the exercises, there was a reduction in the mean of disorders after the exercise as compared to the pre-exercise stage. This finding is dissimilar to that of Nakken's [6] who along with Harvard [13], Kohjer [14] and Bernie [15] witnessed an increase in disorders immediately after doing the exercises.

Epilepsy, on its own, should not be viewed as a reason for condemning participation in physical exercises, though there have been rare cases in which seizures began due to physical activity. Patients who experience seizures during physical activity are probably not monitored by efficient medics. If they regularly take their right medication, they can engage in physical activities as well as other normal people. This can improve their cardio-vascular status and their mental health, and can as well raise their self-confidence and produce social homogeneity among epileptic individuals.

Considering the findings of this research and other related studies on human beings and animals afflicted with epilepsy and the effect of physical activity, sports are suggested as a complementary treatment and a means to enhance physical and spiritual health of epileptic patients. It is expected that neuropsychologists along with physical educationalists take the benefits of sports into account and contrive of serious plans with this regard.

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