

Effect of low glycaemic diet and structured exercise on quality of life and psychosocial functions in children with epilepsy

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Abstract

Objective: The study aimed to investigate the combined effects of structured exercise therapy and a low glycaemic diet on quality of life and psychosocial functions in children with epilepsy.

Methods: Forty-two subjects aged 11 to 17 years and diagnosed with refractory epilepsy were recruited. Structured home-based exercise and a low glycaemic diet designed by exercise and diet specialists were administered for 6 months. The Children's Depression Inventory (CDI) and the Quality of Life in Childhood Epilepsy Questionnaire (QOLCE-55) were administered to compare the effects of the combined treatment after 6 months.

Results: Participants' mean (\pm standard deviation) age was 13.1 ± 2.3 years and mean epilepsy duration was 8.9 ± 4.2 years. The seizure frequency was approximately two to four/day per week in 28 cases and five per day/week in 8 cases. After the study period, there was a significant improvement in seizure frequency and in scores on the CDI and QOLCE-55 scales.

Conclusion: Combined therapy demonstrated a promising improvement in seizure frequency, depression level and quality of life in children with epilepsy.

Keywords

Low glycaemic diet, ketogenic diet, epilepsy, aerobic exercise, children, China, Children's Depression Inventory, Quality of Life in Childhood Epilepsy Questionnaire

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Introduction

Epilepsy is a severe neurological disorder characterised by neuronal hyperexcitability and sudden synchronised cortical electrical discharges that can manifest as seizures.¹ Global epilepsy estimates identified almost 39 million cases in 2015 and 70 million cases in 2018.² Twenty-three million people with epilepsy have physical and psychological comorbidities.³ The causes of epilepsy are brain trauma, tumour or stroke injury, brain infection, genetic mutation and congenital disabilities.⁴ Recently, it has been recognised that impaired astrocyte function and energy homeostasis play a critical role in the pathogenesis of epilepsy.⁵

Neuroprotective and complementary therapies for prevention and treatment of epilepsy have been widely used. These include pharmacological⁶ and non-pharmacological therapies such as diet, acupuncture, herbal medicine, stress management and exercise.⁷ There has been a focus on natural, healing diets and exercise therapy as they produce no side effects. The ketogenic diet (KD) has been used to treat intractable childhood epilepsy⁸ and has positive effects on seizure control and general health.⁹ However, the KD is not a convenient therapy, especially for older children and adolescents with dietary intolerance issues because it contains 80% fat.¹⁰

Low glycaemic index treatment (LGIT) may be useful in the management of epilepsy. LGIT is a balanced diet comprising sources of fat, protein and low glycaemic index carbohydrates, which are digested slowly. The low glycaemic index diet (<50) prevents large postprandial increases in blood glucose compared with the KD and allows more liberal total carbohydrate intake;¹¹ therefore, it may be useful as a first-line dietary therapy for epilepsy.¹²

Evidence shows that aerobic exercise reduces anxiety and psychological stress, and improves functional ability by

increasing levels of endorphins, excitatory hormones in the body.¹³ A recent review suggested that exercise may improve psychosocial function and quality of life in people with epilepsy.¹⁴ Exercise is effective in preventing cortical decay and improving cognition by increasing hippocampal volume and hence reducing the risk of developing dementia.¹⁵ Therefore, this study aimed to examine the effects of structured exercise therapy and low glycaemic diet on psychosocial and neurocognitive functions in children with epilepsy.

Methodology

Participants

This was a single centre quasi-experimental study conducted between 2017 and 2018. Forty-two subjects (26 boys, 16 girls) aged 11 to 17 years already diagnosed with refractory epilepsy were recruited from Qilu Children's Hospital of Shandong University.

Intervention

Exercise and diet specialists designed structured home-based exercise and a low glycaemic diet. Participants were given the low glycaemic diet according to the guidelines published in a previous study.¹⁶ The diet comprised 60% fat, 25% protein and 15% low glycaemic carbohydrates. The amount of total caloric intake was assessed according to body weight. Subjects were advised to perform moderate-intensity aerobic exercise consisting of walking, jogging or cycling for 30 minutes/day, 5 days a week, for 6 months. Parents and caregivers were informed of the complete study protocol and were asked to consult their neurologist during the study, as LGIT can produce some side effects that must be ruled out using several laboratory tests. We administered the Children's Depression Inventory (CDI)¹⁷ and Quality of Life

in Childhood Epilepsy Questionnaire (QOLCE-55)¹⁸ to compare the effects of the combined treatment after 6 months. The CDI and the QOLCE-55 were used to assess participants at baseline and after the intervention. Low scores on the CDI indicate better mental health, and high scores on the QOLCE-55 indicate better quality of life. Parents provided written informed consent, and children provided assent appropriate to their age and developmental level. The local review board (JXC2019-10-61) approved all procedures and the study was conducted according to the Declaration of Helsinki.

Statistical analysis

Data were illustrated as means and standard deviations. The paired t-test was used to observe changes in seizure frequency, CDI scores and QOLCE-55 scores from baseline to post-study using SPSS version 22 (IBM Corp., Armonk, NY, USA). The level of α was set at <0.05 .

Results

Thirty-six patients (23 boys, 13 girls) completed the study. Six patients (three boys and three girls) could not continue the diet and exercise plan and were excluded from the study. The mean age \pm standard deviation was 13.1 ± 2.3 years. The mean (\pm standard deviation) duration of epilepsy was 8.9 ± 4.2 years. Pre-study seizure frequency was approximately two to four/day per week in 28 cases and five/day per week in 8 cases. After the study period, there was a significant improvement in seizure frequency (Figure 1), and in CDI and QOLCE-55 scores (all $P = 0.000$) (Table 1).

Discussion

Epilepsy shows heterogeneity in almost all aspects, including aetiology, onset age, type

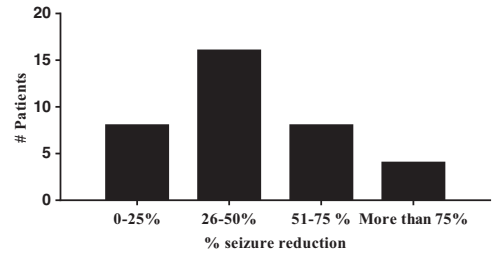


Figure 1. Improvement in seizure frequency after the study (N = 36).

of seizure and treatment response (prognosis and episodic reoccurrence). Dietary treatments modulate energy homeostasis and may be important therapeutic options for epilepsy treatment. The present study used LGIT to provide continuous glucose to the body and aerobic exercises to improve fitness, reduce weight and obesity, decrease stress and oxygenate the brain. The KD, a low carbohydrate diet, has been used to create a metabolic state in which the body uses fat as an energy source.¹⁹ An early form of the KD was used in ancient Greece for epilepsy. In a recent study, the KD compared with surgery showed a 50% reduction in seizures.⁸ However, patients may discontinue a diet owing to inconvenience, gastrointestinal disturbances and hypercholesterolemia.²⁰

As a dietary therapy for people with epilepsy, LGIT allows a more liberal consumption of carbohydrates, which produces stable glucose levels and ketone bodies, a feature of low glycaemic carbohydrates.²¹ LGIT may be a useful treatment for epilepsy owing to its efficacy and mild side effects. The present study showed a significant reduction of seizures after a 6-month dietary and exercise treatment, although no participants showed a 100% recovery from seizures. Our results are comparable with the findings of Pfeifer and her colleagues, who showed a remarkable reduction in seizure frequency.²² LGIT that includes 40 to 60 g of carbohydrates is effective for seizure control and obesity compared with

Table 1. Pre-study and post-study variable scores (N = 36).

Scale	Pre-study Mean \pm SD	Post-study Mean \pm SD	Paired sample t-test (P value)
Seizure frequency/week	3.4 \pm 1.08	2.37 \pm 0.84	0.000
CDI	37.9 \pm 6.6	31.05 \pm 6.3	0.000
QOLCE-55	58.8 \pm 10.02	69.05 \pm 5.4	0.000

SD: standard deviation; CDI: Children's Depression Inventory; QOLCE-55: Quality of Life in Childhood Epilepsy Questionnaire.

high glycaemic index treatment or traditional KDs.²³ The present study showed no uncontrolled or side effects of the diet and exercise treatment. Aerobic exercise can have neuroprotective and antiepileptic effects (seizure reduction), and lead to improved quality of life and social interactions.²⁴ One study limitation was that the measures used were subjective in nature. However, the present findings showed that LGIT, along with aerobic training, controlled seizures in children with refractory epilepsy (most children experienced a 25% to 50% reduction in seizures). This non-pharmacological treatment provides a natural form of healing without side effects. The combined therapy used in this study improved not only children's seizure symptoms, but also their mood, physical functioning, cognitive functioning and social functioning. It reduced anxiety and fear levels, and improved confidence and functional independence.

Conclusion

A combination of low glycaemic diet and aerobic exercise demonstrated promising improvements in seizure frequency, depression levels and quality of life in children with epilepsy.


Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References

1. Boison D and Steinhäuser C. Epilepsy and astrocyte energy metabolism. *Glia* 2018; 66: 1235–1243.
2. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016; 388: 1545–1602.
3. Trinka E, Kwan P, Lee B, et al. Epilepsy in Asia: disease burden, management barriers, and challenges. *Epilepsia* 2019; 60: 7–21.
4. Keezer MR, Sisodiya SM and Sander JW. Comorbidities of epilepsy: current concepts and future perspectives. *Lancet Neurol* 2016; 15: 106–115.
5. Coulter DA and Eid T. Astrocytic regulation of glutamate homeostasis in epilepsy. *Glia* 2012; 60: 1215–1226.
6. Katzung BG (ed.). *Basic and clinical pharmacology*. 14th ed. New York: McGraw-Hill Education, 2017.
7. Perucca P, Scheffer IE and Kiley M. The management of epilepsy in children and adults. *Med J Aust* 2018; 208: 226–233.
8. Liu H, Yang Y, Wang Y, et al. Ketogenic diet for treatment of intractable epilepsy in

- adults: a meta-analysis of observational studies. *Epilepsia Open* 2018; 3: 9–17.
9. Patel A, Pyzik PL, Turner Z, et al. Long-term outcomes of children treated with the ketogenic diet in the past. *Epilepsia* 2010; 51: 1277–1282.
 10. Neal EG, Chaffe H, Schwartz RH, et al. The ketogenic diet for the treatment of childhood epilepsy: a randomised controlled trial. *Lancet Neurol* 2008; 7: 500–506.
 11. Zamil ST. Assessment of the relation between different food items and outcomes of epilepsy in adults. *World Journal of Pharmaceutical Research* 2018; 7: 639–648.
 12. Pfeifer HH, Lyczkowski DA and Thiele EA. Low glycemic index treatment: implementation and new insights into efficacy. *Epilepsia* 2008; 49: 42–45.
 13. Amjad I, Toor H, Niazi IK, et al. Therapeutic effects of aerobic exercise on EEG parameters and higher cognitive functions in mild cognitive impairment patients. *Int J Neurosci* 2019; 129: 551–562.
 14. Allendorfer JB and Arida RM. Role of physical activity and exercise in alleviating cognitive impairment in people with epilepsy. *Clin Ther* 2018; 40: 26–34.
 15. Erickson KI, Voss MW, Prakash RS, et al. Exercise training increases size of hippocampus and improves memory. *Proc Natl Acad Sci U S A* 2011; 108: 3017–3022.
 16. Pfeifer HH and Thiele EA. Low-glycemic-index treatment: a liberalized ketogenic diet for treatment of intractable epilepsy. *Neurology* 2005; 65: 1810–1812.
 17. Allgaier AK, Frühe B, Pietsch K, et al. Is the Children's Depression Inventory Short version a valid screening tool in pediatric care? A comparison to its full-length version. *J Psychosom Res* 2012; 73: 369–374.
 18. Conway L, Widjaja E, Smith ML, et al. Validating the shortened Quality of Life in Childhood Epilepsy Questionnaire (QOLCE-55) in a sample of children with drug-resistant epilepsy. *Epilepsia* 2017; 58: 646–656.
 19. Li HF, Zou Y and Ding G. Therapeutic success of the ketogenic diet as a treatment option for epilepsy: a meta-analysis. *Iran J Pediatr* 2013; 23: 613–620.
 20. Martin-McGill KJ, Jackson CF, Bresnahan R, et al. Ketogenic diets for drug-resistant epilepsy. *Cochrane Database Syst Rev* 2018; 11: CD001903.
 21. Grocott OR, Herrington KS, Pfeifer HH, et al. Low glycemic index treatment for seizure control in Angelman syndrome: a case series from the Center for Dietary Therapy of Epilepsy at the Massachusetts General Hospital. *Epilepsy Behav* 2017; 68: 45–50.
 22. Coppola G, D'Aniello A, Messana T, et al. Low glycemic index diet in children and young adults with refractory epilepsy: first Italian experience. *Seizure* 2011; 20: 526–528.
 23. Rezaei S, Harsini S, Kavooosi M, et al. Efficacy of low glycemic index treatment in epileptic patients: a systematic review. *Acta Neurol Belg* 2018; 118: 339–349.
 24. Tsuji S. Participation of people with epilepsy in sports. *Brain Nerve* 2017; 69: 151–158.