



Intellectual functioning in children with epilepsy: Frontal lobe epilepsy, childhood absence epilepsy and benign epilepsy with centro-temporal spikes



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ABSTRACT

Purpose: The purpose of our study is to describe intellectual functioning in three common childhood epilepsy syndromes – frontal lobe epilepsy (FLE), childhood absence epilepsy (CAE) and benign epilepsy with centro-temporal spikes (BECTS). And also to determine the influence of epilepsy related variables, type of epilepsy, age at epilepsy onset, duration and frequency of epilepsy, and treatment on the scores.

Methods: Intellectual functioning was examined in a group of 90 children with epilepsy (30 FLE, 30 CAE, 30 BECTS), aged 6–15 years, and compared with a control group (30). All subjects obtained a Full Scale IQ ≥ 70 and they were receiving no more than two antiepileptic medications. Participants completed the Wechsler Intelligence Scale for Children – Third Edition. The impact of epilepsy related variables (type of epilepsy, age at epilepsy onset, duration of epilepsy, seizure frequency and anti-epileptic drugs) on intellectual functioning was examined.

Results: Children with FLE scored significantly worse than controls on WISC-III Verbal IQ, Full Scale IQ and Processing Speed Index. There was a trend for children with FLE to have lower intelligence scores than CAE and BECTS groups. Linear regression analysis showed no effect for age at onset, frequency of seizures and treatment. Type of epilepsy and duration of epilepsy were the best indicators of intellectual functioning.

Conclusion: It is crucial that children with FLE and those with a longer active duration of epilepsy are closely monitored to allow the early identification and evaluation of cognitive problems, in order to establish adequate and timely school intervention plans.

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1. Introduction

Many children and adolescents with epilepsy have normal general intellectual functioning,^{1–3} however a lowered intelligence quotient (IQ) is a main consequence of epilepsy in some cases. In a representative community-based study by Anne Berg's team⁴ 26% of the children identified when first diagnosed with epilepsy had a subnormal cognitive function. Most studies using intelligence scales have documented low average range IQ's.^{5–7}

The cause of cognitive problems in epilepsy seems to be multifactorial, that is several intercorrelated factors contribute for deficits in intellectual functioning. Such epilepsy related variables

include: type of epilepsy and underlying aetiology, age at onset, frequency of seizures, duration of epilepsy and treatment (anti-epileptic drugs). The type of epilepsy is considered an important predictor of intellectual functioning. Studies have described below average performances for partial epilepsies and in idiopathic generalized epilepsies.^{8–12} It is well known that children with generalized symptomatic epilepsy are at a higher risk for lower intellectual functioning.^{13–15} In fact in severe epilepsies, like Lennox–Gastaut and West syndromes, mental retardation is seen as part of the syndrome. Age at seizure onset seems to be one of the most important predictors of cognitive outcome. Several studies have identified an increased risk of cognitive dysfunction on children that had an early onset of epilepsy. The study by Cormack et al.¹¹ identified 82% of intellectual impairment in children with epilepsy onset in the first year of life. In the community-based sample of Berg et al.⁴ the most significant factor contributing to IQ impairment was seizure onset before 5 years of age. The negative impact of a longer duration of epilepsy on intellectual performance

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has been described in several types of epilepsy.^{7,10,13} Frequency of seizures is also an important factor that can influence intellectual functioning as several authors have described that children with a history of higher seizure frequency tend to present lower IQ scores.^{6,9,12,15} Finally, polytherapy (taking more than one anti-epileptic drug) seems to have a significant impact on IQ.^{8,15–17}

Intelligence scales, such as the Wechsler Scales gives us a global measure of intellectual abilities, and at the same time they cover different aspects of cognitive functioning (namely, verbal, visuo-spatial, processing speed, attention tasks). Using an intelligence scale may be the first step on neuropsychological assessment of children with epilepsy. The information coming from these scales can help neuropsychologists to identify the cognitive domains which needs further assessment (i.e. language, memory, attention, executive functions, motor functions). Also performance on intelligence scales may facilitate the understanding of academic and behavioural problems^{18,19} and can be used as a baseline for later comparison, depending on the evolution of the epileptic syndrome.

The intelligence scales are probably the instrument most often included in neuropsychological studies of children with epilepsy, but most times their scores are merely used as exclusion/inclusion criteria and only global cognitive measures are reported. The purpose of our study is to compare the WISC-III performance in children with frontal lobe epilepsy (FLE), usually considered to cause problems on cognitive functioning, and children with childhood absence epilepsy (CAE) and benign epilepsy with centro-temporal spikes (BECTS), often considered as benign disorders. We also investigated the influence of epilepsy related variables on intellectual functioning, including type of epilepsy, age at epilepsy onset, duration and frequency of epilepsy, and treatment.

2. Methods

2.1. Participants

The clinical sample included 90 children with epilepsy [30 with frontal lobe epilepsy (FLE); 30 with childhood absence epilepsy (CAE); 30 with benign epilepsy with centro-temporal spikes (BECTS)] and 30 controls. Children with epilepsy were recruited from neuropaediatric units of the Hospital Garcia de Orta and Coimbra's Paediatric Hospital. All children with epilepsy from these geographic areas are referred to these tertiary care paediatric epilepsy outpatient clinics for neurological and neuropsychological care, and therefore they seem representative samples of children and adolescents with FLE, CAE and BECTS.

The child neurologists (i) classified the participants with epilepsy based on the International League Against Epilepsy criteria^{20,21} and (ii) provided for each child information regarding age at epilepsy onset, date of last seizure, frequency of seizures and present treatment. Children with epilepsy were selected based on the following inclusionary criteria: (1) children had to be between 6 and 15 years of age; (2) diagnosis of FLE, CAE or BECTS; (3) they were administered the Wechsler Intelligence Scale for Children – Third Edition (WISC-III)²² to obtain a Full Scale IQ ≥ 70 (WISC-III); and (4) they were receiving no more than two antiepileptic medications.

The group of healthy control children was chosen, from the group that was previously used to standardise the Portuguese version of the WISC-III, to match the experimental group for socio-economic level, age and gender.

2.2. Intelligence assessment

Intellectual functioning was assessed using the Portuguese version of the Wechsler Intelligence Scale for Children – Third

Edition (WISC-III).²² The Portuguese version of the WISC-III was normed on 1354 children aged 6–16 years of age. The sample was stratified according to gender, age, years of education and geographic regions. Geographic regions were based on the 1998 Portuguese Census. This scale allows the calculation of six composite scores: Verbal IQ (VIQ), Performance IQ (PIQ), Full Scale IQ (FSIQ), Verbal Comprehension Index (VCI), Perceptual Organization Index (POI), Processing Speed Index (PSI) (see Table 1); each with a mean of 100 and a standard deviation of 15. There are 13 subtests (10 core and 3 supplemental) that are transformed in scaled scores with a mean of 10 and standard

Table 1
Description of WISC-III composite scores and subtests.

Composite scores	Description
Verbal IQ	Verbal IQ reflects the child's verbal ability and is a good predictor of school achievement. The Information, Similarities, Arithmetic, Vocabulary, Comprehension subtests comprises the Verbal IQ.
Performance IQ	Performance IQ is not as good a predictor of school achievement as the VIQ. This composite score provides a better estimate of fluid activity and is not as loaded with verbal and cultural content as the Verbal IQ. The Picture Completion, Coding, Picture Arrangement, Block Design and Object Assembly subtests comprises the Performance IQ.
Full Scale IQ	Full Scale IQ is a measure of general intellectual functioning. The Information, Similarities, Arithmetic, Vocabulary, Comprehension, Picture Completion, Coding, Picture Arrangement, Block Design and Object Assembly subtests comprises the Full Scale IQ.
Verbal Comprehension Index	Verbal Comprehension Index assesses verbal knowledge and comprehension. The Information, Similarities, Vocabulary and Comprehension subtests comprises the Verbal Comprehension Index.
Perceptual Organization Index	Perceptual Organization Index is a measure of perceptual and organizational dimension. The Picture Completion, Picture Arrangement, Block Design and Object Assembly subtests comprises the Perceptual Organization Index.
Processing Speed Index	Processing Speed Index is a measure of processing speed of nonverbal information. The coding and Symbol Search subtests comprises the Processing Speed Index.
Verbal subtests	
Information	Information assesses the general cultural knowledge and acquired facts.
Similarities	Similarities is a measure of logical abstract thinking and reasoning.
Arithmetic	Arithmetic is a measure of mental arithmetic ability and problem solving.
Vocabulary	Vocabulary assesses verbal fluency, word knowledge and language development.
Comprehension	Comprehension is a measure of social knowledge and practical judgement in social situations.
Digit Span	Digit Span assesses short-term verbal memory and attention.
Performance subtests	
Picture Completion	Picture Completion assesses visual alertness and visual long-term memory.
Coding	Coding is a measure of visual-motor dexterity, associative nonverbal learning and speed.
Picture Arrangement	Picture Arrangement assesses visual comprehension, planning and social intelligence.
Block Design	Block Design is a measure of spatial analysis and nonverbal reasoning.
Object Assembly	Object Assembly assesses perception, assembly skills and flexibility.
Symbol Search	Symbol Search is a measure of perception, speed, attention and concentration.

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