



## Risk Factors for School Problems in Children and Adolescents with Epilepsy

[*Fatores de Risco para Problemas Escolares em Crianças e Adolescentes com Epilepsia*]

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### Abstract

*The purpose of the present study was to describe the school achievement, assessed by teacher ratings, of children and adolescents with common childhood epilepsy syndromes. In addition, the influence of epilepsy related variables, like type of epilepsy [Frontal Lobe Epilepsy (FLE); Childhood Absence Epilepsy (CAE); Benign Epilepsy with Centro-Temporal Spikes (BECTS)], age at epilepsy onset, duration of active epilepsy, frequency of seizures and treatment on school status and school results was investigated. School status and school results for Portuguese and Maths as reported by teachers were examined in 90 children with epilepsy (30 FLE, 30 CAE, 30 BECTS). 30% of these children were receiving support from special education services and 18% had at least repeated one year at school. Children with a longer duration of active epilepsy were more likely to be receiving support from special education services, to have at least repeated one year at school and to have lower classifications on Portuguese and Maths. It is important that children with a longer duration of active epilepsy are targeted as soon as possible for neuropsychological assessment in order to establish effective remedial education plans.*

**Keywords:** frontal lobe epilepsy; childhood absence epilepsy; benign epilepsy with centro-temporal spikes; school performance.

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## Introduction

Academic achievement problems are common in children and adolescents with epilepsy, even in those with normal or near average intellectual functioning (Vinayan, Biji, & Thomas, 2005; Fastenau, Shen, Dunn, & Austin, 2008; Piccinelli et al., 2008; Reilly & Neville, 2011). These learning difficulties seem to be related to specific cognitive deficits identified in several cognitive domains, such as processing speed (Gottlieb, Zelko, Kim, & Nordli, 2012; Lopes et al., 2013), attention (Hernandez et al., 2003; Auclair, Jambaqué, Dulac, LaBerge, & Siéoff, 2005), executive functions (Luton, Burns, & DeFilippis, 2010; D'Agati, Cerminara, Casarelli, Pitzianti, & Curatolo, 2012), memory (Gonzalez, Anderson, Wood, Mitchell, & Harvey, 2007; Cormack, Vargha-Khadem, Wood, Cross, & Baldeweg, 2012), visual-perceptual abilities (Lopes, Simões, & Leal, 2014) and language (Vanasse, Béland, Carmant, & Lassonde, 2005; Caplan et al., 2008).

A considerable percentage of children with epilepsy are supported by special education services, even if neurologically normal. The community based Connecticut Study of Epilepsy (Berg, Smith, Frobish, Levy, Testa, Beckerman, & Shinnar, 2005; Berg, Hesdorffer, & Zelko, 2011) reported that 49% of children with idiopathic or cryptogenic epilepsy benefited from special education services. Similarly, in a non-published Portuguese study 46% of children with epilepsy were included in special education (Lopes, 2007). Also, it has been described that for a large percentage of children the initiation of special education measures (Berg et al., 2005) or repetition of years at school (Schouten, Oostrom, Jennekens-Schinkel, & Peters, 2001) precedes the diagnosis of epilepsy. These data suggests that cognitive and behavioural comorbidities may precede the onset of epilepsy.

The factors underlying academic vulnerability are not well understood, and are likely to be multi-factorial. Type of epilepsy (Aldenkamp, Weber, Wihelmina, Overweg-Plandsoen, Reijts, & Mil, 2005; Berg et al., 2005), age at epilepsy onset (Fastenau et al., 2008; Piccinelli et al., 2008), duration of epilepsy (Adewuya, Oseni, & Okeniyi, 2006), frequency of seizures (McNelis, Johnson, Huberty, & Austin, 2005) and whether and what antiepileptic drugs are used (Bulteau, Jambaqué, Viguié, Kieffer, Dellatolas, & Dulac, 2000) are some of the epilepsy related variables that have been identified as potential causes for academic problems.

In addition, neuropsychological functioning has been related to academic achievement. Fastenau, Shen, Dunn, Perkins, Hermann, & Austin (2004) have identified three underlying



neuropsychological constructs that were strongly associated with academic achievement: “Verbal/Memory/Executive Functioning”, “Rapid Naming/Working Memory” and “Psychomotor”. Aldenkamp et al. (2005) studied three neuropsychological areas (Intelligence, Reaction Times and Memory Function) and he found that the dominant neuropsychological factor responsible for academic difficulties was lower intelligence. In addition attention deficits (Williams, Philips, Griebel, Sharp, Lange, Edgar, & Simpson, 2001) have been reported in children with unsatisfactory academic progress.

Psychosocial variables and family functioning are likely to moderate the relationship between neuropsychological impairment and academic difficulties (Austin & Dunn, 2008). There is a high risk of psychosocial problems in children with epilepsy (Hoie, Sommerfelt, Waaler, Alsaker, Skeidsvoll, & Mykletun, 2006; Berg, Vickrey, Testa, Levy, Shinnar, & DiMario, 2007), but most studies on academic achievement do not include the assessment of psychosocial functioning. The presence of Attention Deficit Hyperactivity Disorder (Fastenau et al., 2008), lower self-esteem (Adewuya, Oseni, & Okeniyi, 2006), social skill deficits and depressive symptomatology (Sturniolo & Galletti, 1994) as well as negative attitudes toward epilepsy (Austin & Dunn, 2008) have been associated with school difficulties. The presence of parental mental health problems (Dunn, Johnson, Perkins, Fastenau, Byars, deGrauw, & Austin, 2010) and disorganized or unsupportive home environments (Fastenau et al., 2004; Adewuya, Oseni, & Okeniyi, 2006) are both identified as risk factors for worse academic results.

The goal of the present study was to describe the school achievements of children and adolescents with common childhood epilepsy syndromes. Also, we investigated the influence of the following epilepsy related variables on school status and school achievements, assessed as the results described by teachers in Portuguese and Maths, including: (i) type of epilepsy (Frontal Lobe Epilepsy, Childhood Absence Epilepsy, Benign Epilepsy with Centro-Temporal Spikes), (ii) age at epilepsy onset, (iii) duration of active epilepsy, (iv) frequency of seizures and (v) treatment (no medication, monotherapy, duotherapy).



## Methods

### Participants

Participants were 90 children with epilepsy, who were recruited from neuropaediatric units of Hospital Garcia de Orta and Coimbra's Paediatric Hospital. This study was approved by the institutional review boards of both institutions. Children with epilepsy were selected based on the following inclusionary criteria: They were (i) between 6 and 15 years of age; (ii) diagnosed with Frontal Lobe Epilepsy (FLE), Childhood Absence Epilepsy (CAE) or Benign Epilepsy with Centro-Temporal Spikes (BECTS); (iii) administered the Wechsler Intelligence Scale for Children – Third Edition and obtained a Full Scale IQ  $\geq 70$  (Wechsler, 2003; Lopes et al., 2013); and (iv) receiving no more than two antiepileptic medications.

### Instruments

As part of the Achenbach Teacher's Report Form (Achenbach, 1991; Fonseca, Rebelo, Ferreira, Simões, & Cardoso, 1995; Albuquerque, Fonseca, Simões, Pereira, & Rebelo, 1999), teachers informed us: (i) whether the child benefited from special education services; (ii) whether he or she had repeated years at school; and (iii) about the classification of their performance in Portuguese and Maths (1-Very Inferior, 2-Inferior, 3-Normal, 4-Superior, 5-Very Superior).

### Procedures

Statistical analysis was carried out with the assistance of the program *Statistical Package for the Social Sciences* (SPSS, Chicago, IL, USA – Version 17.0). The demographic and the neurological variables of the three epilepsy groups (FLE, CAE, BECTS) were submitted to analysis of variance (ANOVA) to determine if the groups were matched. Also, the associations between categorical variables were analyzed using Chi-Square Tests (gender, mother's years of education, seizure frequency and treatment). To test differences in the school variables (type of school attendance, retentions, results for Portuguese and Maths) for the different variables related to epilepsy (type of epilepsy, age at epilepsy onset, duration of active epilepsy, frequency of seizures and treatment) nonparametric tests (Kruskal Wallis for

3 groups and Mann-Whitney for 2 groups) were conducted. Results were judged statistically significant if the  $p$ -value was identical to or smaller than .05.

## Results

There were no significant differences between groups for age at testing and parental education (see Table 1). For the variable gender the Frontal Lobe Epilepsy group differed from the CAE and BECTS groups, which can be explained by the fact that FLE seems to be more frequent in males (Braakman et al., 2012). Gender differences for the school results were tested, and no differences were reported between boys and girls. For the neurological features no significant differences were observed between the groups (FLE, CAE and BECTS) for any of the epilepsy-related variables (age at onset of epilepsy, active duration of epilepsy, seizure frequency and treatment).

**Table 1** - Demographic and neurological features.

	<b>FLE (N=30)</b>	<b>CAE (N=30)</b>	<b>BECTS (N=30)</b>	<b><i>p</i>-Value</b>
<b>Age</b>	<i>M</i> =10.13 ( <i>SD</i> =2.73)	<i>M</i> =9.93 ( <i>SD</i> =2.54)	<i>M</i> =9.77 ( <i>SD</i> =2.43)	.858
<b>Gender</b>				
<b>Boys</b>	77% ( <i>N</i> =23)	30% ( <i>N</i> =9)	33% ( <i>N</i> =10)	.001
<b>Girls</b>	23% ( <i>N</i> =7)*	70% ( <i>N</i> =21)	67% ( <i>N</i> =20)	
<b>Years of education (mother)</b>				
<b>Up to 9<sup>th</sup> grade</b>	17% ( <i>N</i> =5)	23% ( <i>N</i> =7)	20% ( <i>N</i> =6)	.660
<b>9<sup>th</sup> grade</b>	30% ( <i>N</i> =9)	30% ( <i>N</i> =9)	47% ( <i>N</i> =14)	
<b>12<sup>th</sup> grade</b>	30% ( <i>N</i> =9)	20% ( <i>N</i> =6)	20% ( <i>N</i> =6)	
<b>Superior</b>	23% ( <i>N</i> =7)	27% ( <i>N</i> =8)	13% ( <i>N</i> =4)	
<b>Age at onset (years)</b>	<i>M</i> = 6.40 ( <i>SD</i> =3.10)	<i>M</i> =6.83 ( <i>SD</i> =2.32)	<i>M</i> =6.77 ( <i>SD</i> =2.43)	.792
<b>Seizure frequency</b>				
<b>No seizures (last 6 months)</b>	57% ( <i>N</i> =17)	70% ( <i>N</i> =21)	60% ( <i>N</i> =18)	.177
<b>&lt; 1 a month</b>	30% ( <i>N</i> =9)	13% ( <i>N</i> =4)	37% ( <i>N</i> =11)	
<b>≥ 1 a month</b>	13% ( <i>N</i> =4)	17% ( <i>N</i> =5)	3% ( <i>N</i> =1)	
<b>Active duration (months)</b>	<i>M</i> =27.57 ( <i>SD</i> =36.24)	<i>M</i> =22.63 ( <i>SD</i> =17.95)	<i>M</i> =20.90 ( <i>SD</i> =26.44)	.632
<b>Treatment</b>				
<b>No medication</b>	7% ( <i>N</i> =2)	13% ( <i>N</i> =4)	27% ( <i>N</i> =8)	.087
<b>Monotherapy</b>	80% ( <i>N</i> =24)	73% ( <i>N</i> =22)	73% ( <i>N</i> =22)	
<b>Duotherapy</b>	13% ( <i>N</i> =4)	13% ( <i>N</i> =4)	—	

\* Differs from CAE ( $p=.001$ ) and from BECTS ( $p=.001$ ).



All the children included in the study attended mainstream schools, without separate classrooms for children with special needs. 30% ( $N=27$ ) of the 90 children were receiving support from special education services, and 18% ( $N=16$ ) had at least repeated one year at school. According to their teachers, 36% ( $N=32$ ) in Portuguese and 40% ( $N=36$ ) in Maths were performing below expected. The results of the comparison between the 3 groups of children with epilepsy (FLE, CAE and BECTS) revealed no significant differences for type of epilepsy in school status and performance on Portuguese and Maths (see Table 2).

**Table 2** - School status.

	<b>FLE (N=30)</b>	<b>CAE (N=30)</b>	<b>BECTS (N=30)</b>	<b>p-value</b>
<b>School attendance</b>				
<b>Normal</b>	60% ( $N=18$ )	70% ( $N=21$ )	80% ( $N=24$ )	.243
<b>Special education</b>	40% ( $N=12$ )	30% ( $N=9$ )	20% ( $N=6$ )	
<b>Retentions at school</b>	20% ( $N=6$ )	27% ( $N=8$ )	7% ( $N=2$ )	.122
<b>Portuguese classifications</b>				
<b>Very inferior</b>	27% ( $N=8$ )	10% ( $N=3$ )	–	.215
<b>Inferior</b>	13% ( $N=4$ )	33% ( $N=10$ )	23% ( $N=7$ )	
<b>Normal</b>	50% ( $N=15$ )	50% ( $N=15$ )	70% ( $N=21$ )	
<b>Superior</b>	10% ( $N=3$ )	7% ( $N=2$ )	3% ( $N=1$ )	
<b>Very superior</b>	–	–	3% ( $N=1$ )	
<b>Math classifications</b>				
<b>Very inferior</b>	20% ( $N=6$ )	20% ( $N=6$ )	3% ( $N=1$ )	.323
<b>Inferior</b>	27% ( $N=8$ )	23% ( $N=7$ )	27% ( $N=8$ )	
<b>Normal</b>	40% ( $N=12$ )	50% ( $N=15$ )	60% ( $N=18$ )	
<b>Superior</b>	13% ( $N=4$ )	7% ( $N=2$ )	10% ( $N=3$ )	
<b>Very superior</b>	–	–	–	

We also compared children with an earlier age at onset (age at onset  $\geq 6$  years of age) with those with latter onset and the groups didn't differ. Also the school status of these children did not differ when frequency of seizures and treatment were analyzed. The only variable related to epilepsy that had an impact on school measures was the duration of active epilepsy. Children with a longer duration of active epilepsy (2 years or more) were more likely to be receiving support from special education services [ $U=658.0$ ,  $p=.006$ ], to have at least repeated one year at school [ $U=712.5$ ,  $p=.010$ ], or to have lower classifications on Portuguese [ $U=662.5$ ,  $p=.017$ ] and Maths [ $U=647.0$ ,  $p=.014$ ].



## Discussion

Our study confirms results from several studies (Berg et al., 2005; Braakman et al., 2012) that report a higher percentage of children included in special education programs compared to normal children. 30% of the 90 children with epilepsy were receiving support from special education services in mainstream schools. While inclusion in special education programs in mainstream schools among the general population in Portugal is 2.6% (Direção Geral de Inovação e Desenvolvimento Curricular – Curriculum Development and Innovation General Service, 2009). Teacher ratings reported in our study, together with other studies that describe teachers assessment of the child's academic abilities (McNelis et al., 2005; Katzenstein, Fastenau, Dunn, & Austin, 2007), also excluding children with a diagnosis of mental retardation, shows that teachers ratings of school performance of children with epilepsy are lower. Academic achievement problems are also reported in studies that use standardized achievement tests, such as the Wide Range Achievement Test that provides an assessment of reading, writing and computational abilities (Schoenfeld, Seidenberg, Woodard, Hecox, Inglese, Mack, & Hermann, 1999; Aldenkamp et al., 2005; Piccinelli et al., 2008).

The present study found that children with a longer duration of epilepsy were more likely to present lower scores in Portuguese and Maths. Also these children with a longer duration of epilepsy benefited more frequently from special education services and were more likely to have repeated years at school. This finding is supported by previous studies (Seidenberg, Beck, Geisser, O'Leary, Giordani, & Berent, 1988; Adewuya, Oseni, & Okeniyi, 2006). Also, the negative impact of a longer duration of epilepsy has been described in the study of neurocognitive functions, namely on intellectual functioning (Singhi, Bansal, Singhi, & Pershad, 1992; Bulteau et al., 2000; Caplan et al., 2008; Sherman, Brooks, Fay-McClymont, & MacAllister 2012), memory (Nolan et al., 2004; Riva et al., 2005) and attention (Riva et al., 2005; Caplan et al., 2008). The relationship of chronic epilepsy and neurobehavioral problems is highlighted by Hermann's studies (Hermann et al., 2002; Seidenberg, & Hermann, 2010), that show that increased duration of epilepsy is associated with lower performances in intellectual and memory functions, which suggest progressive cognitive effects.



The limitations of the present study include the fact that school results were rated by students' teachers that were aware that their pupils suffered from epilepsy. Similar studies that have also used teachers' ratings have reported that the diagnosis of epilepsy may lower teachers' expectations of academic performance of children with epilepsy (Williams, 2003; Katzenstein et al., 2007). Therefore future studies, that intend to study risk factors for academic achievement, should include standardized measures of school achievement (not available for Portuguese). Secondly, our study did not comprise the study of neurocognitive functioning of these children. Another limitation of the present study was the fact that it did not include a control group matched for age and gender.

Future studies of academic performance in children and adolescents with epilepsy should be performed with large populations and use standardized tests of academic achievement (covering multiple aspects of reading, writing and mathematics), comprehensive protocols of neuropsychological functioning (including measurements of intellectual functioning, attention, executive functions, processing speed, memory, visuoperceptive skills and language), as well as emotional, behavioural and family functioning testing. The study of the performance in these areas, along with the characterization of the clinical variables related to epilepsy (type of epilepsy, age at onset of epilepsy, frequency of seizures, duration of active epilepsy and treatment) will help the understanding of the risk factors that lead to academic difficulties. The determination of epilepsy related variables and neuropsychological areas that correlate with school problems will help to identify and screen children at risk for academic failure.

In conclusion, we have shown that academic achievement problems are frequent on children with epilepsy. In our study, a longer duration of active epilepsy was identified as the risk factor for problems in school performance. These children should be targeted, as soon as possible, for neuropsychological assessment in order to establish appropriate and effective remedial education plans.





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## Fatores de Risco para Problemas Escolares em Crianças e Adolescentes com Epilepsia

### Resumo

*O objetivo da presente investigação foi o de caracterizar os resultados escolares, avaliados pelas classificações das professoras e professores, de crianças e adolescentes com síndromes epiléticas comuns. Adicionalmente foi investigado o impacto das variáveis relativas à epilepsia – tipo de epilepsia [Epilepsia do Lobo Frontal (ELF), Epilepsia de Ausências na Criança (EAC), Epilepsia Benigna com Pontas Centro-Temporais (EBPCT)], idade de início da epilepsia, duração ativa da epilepsia, frequência das crises e tratamento – no estatuto escolar e nos resultados escolares. O estatuto escolar e os resultados escolares nas disciplinas de Português e Matemática foram examinados em 90 crianças com epilepsia (30 ELF, 30 EAC, 30 EBPCT). 30% destas crianças encontravam-se abrangidas pelo ensino especial e 18% já haviam sofrido pelo menos uma retenção escolar. As crianças com uma duração ativa da epilepsia mais longa apresentaram uma maior probabilidade de estarem abrangidas pelo ensino especial ou de terem ficado retidas, bem como resultados escolares mais baixos nas disciplinas de Português e Matemática. É fundamental que as crianças com maior duração ativa da epilepsia sejam sinalizadas precocemente para avaliação neuropsicológica, com o objetivo de estabelecer planos de intervenção educativa adequados.*

**Palavras-chave:** epilepsia do lobo frontal; epilepsia de ausências na criança; epilepsia benigna com pontas centro-temporais; desempenho escolar.

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