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Review article

# The impact of epilepsy on academic achievement in children with normal intelligence and without major comorbidities: A systematic review

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ABSTRACT

*Purpose:* To systematically examine published literature which assessed the prevalence of academic difficulties in children with epilepsy (CWE) of normal intelligence, and its associating factors.

*Methods:* A search was conducted on five databases for articles published in English from 1980 till March 2015. Included were studies who recruited children (aged 5–18 years), with a diagnosis or newly/recurrent epilepsy, an intelligent quotient (IQ) of ≥70 or attending regular school, with or without a control group, which measured academic achievement using a standardised objective measure, and published in English. Excluded were children with learning difficulties, intellectual disabilities (IQ < 70) and other comorbidities such as attention deficits hyperactive disorder or autism. Two pairs of reviewers extracted the data, and met to resolve any differences from the data extraction process.

*Results:* Twenty studies were included. The majority of the studies assessed "low achievement" whist only two studies used the IQ-achievement discrepancy definition of "underachievement". Fourteen studies (70%) reported that CWE had significantly lower academic achievement scores compared to healthy controls, children with asthma or reported norms. The remaining six studies (30%) did not report any differences. CWE had stable academic achievement scores over time (2–4 years), even among those whose seizure frequency improved. Higher parental education and children with higher IQ, and had better attention or had a positive attitude towards epilepsy, were associated with higher academic achievement score. Older children were found to have lower academic achievement score.

*Conclusions:* In CWE of normal intelligence, the majority of published literature found that academic achievement was lower than controls or reported norms. The high percentages of low achievement in CWE, especially in the older age group, and the stability of scores even as seizure frequency improved, highlights the need for early screening of learning problems, and continued surveillance.

## 1. Introduction

Academic difficulty has been reported among children with epilepsy (CWE), even when these children have normal intelligence (i.e. an IQ ≥ 70) (Fastenau et al., 2008; McNelis et al., 2005; Mitchell et al., 1991), particularly in mathematics and reading (Fastenau et al., 2008; Jackson et al., 2013; Puka et al., 2015). However, studies on academic achievement in childhood epilepsy have relied on subjects recruited from clinical settings which tend to include CWE who have below average intelligence (an IQ < 70) (Fastenau et al., 2008; McNelis et al., 2005; Reilly et al., 2014). Therefore, the true prevalence of academic difficulties in CWE of normal intelligence is not known. In a community based study conducted in the United States, CWE were found to have a high rate of school difficulties and grade repetition (Russ et al., 2012). If CWE are unable to progress as well as their peers in school, and tend to drop out of school earlier, it may impact on their social outcomes as they progress into adulthood (Sillanpaa et al., 1998). A study in the United Kingdom found that 31% of adults who had childhood epilepsy pursued higher education, compared to 48% of normal population (Chin et al., 2011). The same study showed the unemployment rate among adults with childhood epilepsy was 23% as compared with only 9% of the normal population (Chin et al., 2011).

Due to the nature of epilepsy as a disease, and the side effects of its treatment, CWE may have specific learning problems such as inattention and working memory that influence on classroom learning and academic achievement (Reilly and Neville, 2011), Although seizure

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variables (e.g. age of seizure onset, effects of antiepileptic drug) may affect academic achievement, study findings are conflicting (Aldenkamp et al., 2005; Williams et al., 2001).

Family factors may also contribute to academic difficulties in CWE (Chambers et al., 2014; McNelis et al., 2005; Mitchell et al., 1991). Negative parenting such as harsh or inconsistent methods on how a parent disciplines a child, may deter a child from learning (Oostrom et al., 2003). A parent's mental health may also affect the child. Greater parent's anxiety may cause a child with epilepsy to withdraw from society and learning, as CWE usually internalize their anxiety and depression, thus making learning more difficult (Dunn et al., 2010). Mitchell et al. (1991) reported that encouragement from parents, as well as family participation in promoting positive emotional and physical growth in CWE, may promote better academic achievement.

Child psychosocial and school factors may also have a significant impact on academic achievement. CWE who have negative attitudes toward their illness, have a low self-esteem, and poor motivation have poorer academic achievement (Austin et al., 1998). These children will feel less positive about school as they are worried about how they will perform in examinations, are anxious when their teacher calls on them to answer questions (Austin et al., 1998). McNelis et al. (2005) suggested that teacher's involvement in assessing and monitoring CWE who are at risk for academic difficulties is important to help CWE success in academic achievement (McNelis et al., 2005).

A search of published literature revealed that to date, no systematic review has been performed on the impact of epilepsy on academic achievement in children with epilepsy and normal intelligence (IQ ≥ 70). A literature review by Reilly et al. in 2011 included studies which ultilized both subjective (such as teacher's reports) and objective measures of academic achievement, and recruited mixed population of children that attended normal as well as special education schools (Reilly and Neville, 2011).

The objective of this review is to systematically examine published literature which focused on the academic achievement in CWE with normal intelligence (IQ > 70) and without comorbidities, with respect to the prevalence of academic difficulties, and the possible factors associated with academic achievement.

## 2. Methods

### 2.1. Type of outcome

The types of patient outcome assessed were the scores of academic achievement based on standardized objective instruments in CWE.

### 2.2. Type of study

The type of study included were cross sectional and longitudinal studies.

### 2.3. Search strategies

The PRISMA guideline was used to guide our search strategy (Moher et al., 2009). A search was conducted on 5 databases: ERIC, PubMed, CINAHL, WoS, and PsycINFO for all studies assessing academic achievement in CWE, until March 2015. Medical Subject Headings (MESH) definitions of ["epilep*", "seizure"] and ["child*", "school-child*","school age*, 'preschool*', "kid*, 'adoles*', "teen*", "boy*", "girl*", "paediatric*", "school", "primary school*", "secondary school*", "elementary school*", "high school*"] was used to defined the study population. In addition, specific MESH definitions to describe outcomes such as ["academic", "education", "cogni*", "achievement*", "underachievement*", "assessment*, 'low achievement*'].

### 2.4. Inclusion and exclusion criteria

Published articles which met the following criteria were considered for inclusion: cross sectional and longitudinal studies, in English, conducted in children with a diagnosis or newly or recurrent epilepsy, aged 5–18 years, with an IQ ≥ 70 and attending regular school, with or without a control group, and which measured academic achievement using a standardised objective instrument (A child was considered to have epilepsy when diagnosed by a paediatric neurologist). Only studies published as full text article were included. Entire papers were read before they were included. Excluded were children with learning difficulties, intellectual disabilities (IQ < 70) and other comorbidities such as autism. In addition, studies which reported on academic achievement measurement using unstandardized subjective instrument and article published only in abstract were excluded.

### 2.5. Data extraction

Two forms were used to extract data: the "Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies" (NIH, 2004) and a self-developed data extraction form.

These forms were pilot-tested on five randomly-selected studies. Two pairs of reviewers (SWW/WYL and LCO/PSML) extracted data from each study. The two pairs then met to resolve any differences from the data extraction process. Due to substantial heterogeneity in the study design and outcomes measure of the articles reviewed, no attempt was made to summarize the data using meta-analysis.

## 3. Results

The number of studies which met the review inclusion criteria is shown in Fig. 1.

### 3.1. Study characteristics of included studies

Out of 20 studies, 13 studies were conducted in the United States (Austin et al., 1998, 1999; Bailet and Turk, 2000; Caplan et al., 2006; Drewel et al., 2009; Hermann et al., 2008; Jackson et al., 2013; Jones et al., 2010; Mitchell et al., 1991; Schoenfeld et al., 1999; Seidenberg et al., 1986; Williams et al., 2001; Williams et al., 1996), three in the Netherlands (Aldenkamp et al., 2005; Braakman et al., 2012; Overvliet et al., 2011), two in Brazil (Miziara et al., 2012; Tedrus et al., 2009), one in Jamaica (Chambers et al., 2014), and one in Turkey (Gulgonen et al., 2000).

Fifteen studies were conducted at a single site (a public hospital) (Aldenkamp et al., 2005; Bailet and Turk, 2000; Braakman et al., 2012; Chambers et al., 2014; Gulgonen et al., 2000; Hermann et al., 2008; Jackson et al., 2013; Mitchell et al., 1991; Miziara et al., 2012; Overvliet et al., 2011; Schoenfeld et al., 1999; Seidenberg et al., 1986; Tedrus et al., 2009; Williams et al., 2001; Williams et al., 1996). The remaining 5 studies were conducted in more than one site: two were conducted in both a public and private hospital (Austin et al., 1998, 1999), one was conducted in a public hospital, private hospital and the community (Caplan et al., 2006; Jones et al., 2010), whilst one was conducted in a public hospital, private hospital and school (Drewel et al., 2009).

Sixteen were cross sectional studies (Aldenkamp et al., 2005; Austin et al., 1998; Braakman et al., 2012; Caplan et al., 2006; Chambers et al., 2014; Drewel et al., 2009; Gulgonen et al., 2000; Jackson et al., 2013; Mitchell et al., 1991; Miziara et al., 2012; Overvliet et al., 2011; Schoenfeld et al., 1999; Seidenberg et al., 1986; Tedrus et al., 2009; Williams et al., 2001; Williams et al., 1996), and four were longitudinal studies (Austin et al., 1999; Bailet and Turk, 2000; Hermann et al., 2008; Jones et al., 2010) (Tables 1 and 2, respectively).

Twelve out of 20 studies had a control group (Aldenkamp et al., 2005; Austin et al., 1998, 1999; Bailet and Turk, 2000; Chambers et al.,