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Cognition, academic achievement, language, and psychopathology in pediatric chronic epilepsy: Short-term outcomes

Jana E. Jones, PhD¹, Prabha Siddarth, PhD², Suresh Gurbani, MD, PhD³, W. Donald Shields, MD⁴, and Rochelle Caplan, MD²

¹Department of Neurology, University of Wisconsin School of Medicine and Public Health, Madison, WI

²Semel Institute for Neuroscience and Human Behavior, University of California Los Angeles, CA

³Department of Pediatrics, University of California Irvine, CA

⁴Department of Pediatrics, University of California Los Angeles, CA

Abstract

Children with epilepsy and control children were followed over a two year interval. Comorbidities of epilepsy, often defined as problems related to IQ, academic achievement, language, and psychopathology, were evaluated prospectively. It was hypothesized that over time a) the presence of comorbidities would predict worse outcomes, and b) epilepsy variables would negatively impact comorbidities. The study included 39 children with complex partial seizures (CPS), 25 children childhood absence epilepsy (CAE), and 27 healthy children, aged 7.6-16.1 years. The findings were notable for stability over the interval in all three groups. Additionally, baseline seizure variables and change over the interval appear to play a role in IQ and math achievement scores of children with epilepsy with average IQ and in the reading achievement scores of those with below average IQ. However, seizures variables at baseline and follow-up were not predictors of DSM-IV diagnoses, depression, anxiety or behavioral problems.

Keywords

Pediatric Epilepsy; academic achievement; cognition; language; psychopathology; prospective study

Introduction

Academic achievement, cognitive and linguistic deficits, and psychopathology have been identified as comorbidities in children with both new onset and chronic epilepsy [1-17]. A number of epilepsy related factors appear to contribute to these problems including seizure frequency [18-21], recurrent seizures [5,8,20], age of seizure onset [13,18,22,23], duration of

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Manuscript Correspondence: Jana E. Jones, PhD, Department of Neurology, University of Wisconsin School of Medicine and Public Health, H4/665 CSC, 600 Highland Avenue, Madison, WI 53792-6180, jejones@neurology.wisc.edu, Phone: 608-262-5481, Fax: 608-265-0172.

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illness [24,25], antiepileptic drugs (AEDs) [19,26,27], type of epilepsy [1,3,15,28], and focal EEG findings [7,15,29]. However, across studies the findings inconsistently implicate these epilepsy related variables [13,30-33]. In addition, often variables such as family factors [12, 34], preexisting learning problems, psychopathology [10,35,36], and neuropsychological impairments [11,12] are found to be significant factors influencing academic underachievement, cognitive and linguistic deficits, as well as behavior problems in children with epilepsy.

The majority of comorbidity studies are cross sectional in nature, and limit our understanding regarding how children with epilepsy perform and develop over time. A few prospective studies have been conducted relatively recently in order to try to understand the course (e.g., decline, improve, or maintain over time) and predictors (e.g. epilepsy variables and psychosocial variables) [7,37,38] of these comorbidities in new onset and chronic childhood epilepsy. Some studies examined academic achievement [6,13,39,40], several investigated IQ [38,41-43], and others behavioral problems [8,34]. In addition to the outcome measures, these prospective studies also differ in terms of the duration of the epilepsy with some studies including only children with new onset epilepsy [8,10,34,36,37] while others included children with chronic epilepsy [6,40,42,43]. Additionally, only three prospective, controlled studies examined cognition, language, academic achievement and behavioral problems collectively in the same children with epilepsy [7,10,36,37]. These prospective studies indicated that children with epilepsy frequently underperform in academic achievement, attention, executive functioning and have behavioral problems compared to healthy control children. In terms of change over time, the evidence indicates that children maintain their performance overtime [7,36,37] and do not appear to catch up to their peers.

In order to understand the overall impact of the comorbidities of childhood epilepsy on neurobehavioral development we examined two hypotheses. First, we hypothesized that the presence of comorbidities would predict worse neurobehavioral outcomes over time. The sample was divided into the following three groups based on Full Scale IQ at baseline: children with epilepsy with below average Full Scale IQ, children with epilepsy with average Full Scale IQ, and healthy control children with average Full Scale IQ. We compared all three groups at baseline, and the change over time in measures of cognition (IQ), language, academic achievement (i.e., reading, math reasoning, and spelling) and psychopathology (psychiatric diagnosis, parent report of behavior problems, child self report of depression and anxiety).

To address the second hypothesis that epilepsy variables negatively impact the comorbidities over time, we examined seizure variables at baseline and follow-up (i.e., seizure frequency/control, age of onset, duration of illness, and number of AEDs) as predictors of decline in performance over time for each comorbidity (i.e., cognition, academic achievement, language and psychopathology) within the below average and average epilepsy groups.

Methods

Participants

A total of 155 children (94 children with epilepsy and 61 control children) were initially recruited and enrolled in the original 2 year follow-up study and 91 (58.7%) completed the study. All of the children were recruited specifically for this prospective study of comorbidities in epilepsy; it was not a part of their clinical evaluation. The study included 39 children with complex partial seizures (CPS), 25 children childhood absence epilepsy (CAE), and 27 healthy children, aged 7.6-16.1 years who were followed over a mean interval of 22.9 months (SD = 6.5). Significantly more children with epilepsy (N=64, 68.1%) than control children (N=27, 44.3%) returned for a follow-up assessment ($\chi^2(1) = 8.66, p=.003$). Among the children who returned at follow-up, those with epilepsy were significantly younger than the controls ($t(91)$

= 2.0, $p = .05$). However, there were no significant demographic or epilepsy-related differences including type of epilepsy (69.4% CAE, 67.2% CPS) in the subjects who participated at follow-up and those who did not within the two groups.

Among the follow-up study participants, there were also no significant differences in socioeconomic status between children with epilepsy and control children using the Hollingshead two factor index [44] in which levels I and II are classified as high and levels III-V as low. There were significantly more children of Caucasian origin in the CPS group than the control children and children with CAE ($\chi^2 (2) = 9.23, p = .01$). Children with CPS were more likely to be taking antiepileptic medications (monotherapy or polytherapy) compared to children with CAE ($\chi^2 (1) = 6.24, \text{exact } p = 0.02$).

Children with epilepsy were recruited from tertiary and community sources. 42.5% of children with CPS and 28% with CAE were recruited from tertiary centers (e.g., UCLA and USC clinics) and 57.5% of children with CPS and 72% with CAE were from community sources (i.e. Los Angeles and Anaheim Kaiser Permanente, Los Angeles and San Diego Chapters of the Epilepsy Foundation of America, private practices). More subjects were recruited from the community in the CAE vs. CPS participants, but this was not a significant difference ($\chi^2 (1) = 1.39, p = .24$). At each site a pediatric neurologist made the diagnosis of CPS or CAE based on clinical history and EEG findings, according to the International Classification of Epilepsy [45]. Children with a clinical history of CPS but no EEG evidence of epileptic activity were also included in this study.

Children with epilepsy were excluded from the study for the following reasons: mixed seizure disorders, previous epilepsy surgery, magnetic resonance imaging (MRI) or computed tomography (CT) evidence of brain abnormality other than hippocampal sclerosis, atypical spike and wave complexes, a metabolic disorder, a hearing disorder, and bilingual speakers of American English who did not attend English-speaking schools or speak English at home. A UCLA pediatric neurology investigator (WDS) reviewed the history, EEG records at or about the time of diagnosis, and diagnosis of each child from each recruitment site. If there was no agreement on the epilepsy diagnosis the child was excluded from the study.

Information was obtained from parents and medical records regarding seizure frequency during the past year, current AEDs, age at seizure onset, duration of seizure disorder, lifetime history of prolonged seizures (i.e., >5min) and febrile convulsions. EEGs, completed soon after the epilepsy diagnosis, were available for all 39 children with CPS, of whom 4 had no focal epileptic activity and 27 had epileptic activity in the fronto-temporal region: 14 left, 8 right, and 10 bilateral epileptic activity. Seven children with CPS had background slowing, and 3 had secondary generalization. Twenty-three CAE children had 3 per second spike and wave, 3 children with CAE had generalized tonic clonic convulsions, and 1 CAE child had background slowing.

Healthy control children were recruited from four public schools and two private schools in the community. A telephone screening interview was conducted with the parent, and each child was screened for neurological, language or hearing impairments. Children were excluded if they screened positive for any of these disorders in the past or at the time of the study.

Procedures

After the procedures were fully explained, written informed consent and assent were obtained from parents and children, respectively. This study was approved by the Human Subjects Protection Committees of the University of California, Los Angeles. Study procedures were prospective, and each subject participated in a baseline and follow-up evaluation an average of 22.9 (SD = 6.9) months later.

Psychopathology

Kiddie Schedule for Affective Disorders and Schizophrenia–Present and Lifetime

Version (K-SADS): The KSADS [46] was administered by a psychiatrist (RC) or a trained research assistant separately to each child and parent. Due to the large number of diagnoses relative to the number of participants in each diagnostic category we grouped the diagnoses as follows: disruptive, affective/anxiety, schizophrenia, other, and mixed.

The child and parent often talked about the child's seizures during the interview; as a result, the interviewers were not blinded with regard to seizure disorder diagnosis. A second clinician reviewed videotapes of the child interviews, and a consensus diagnosis was reached based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)[47].

Given the large number of diagnoses relative to the number of subjects in each diagnostic group, we grouped the diagnoses as follows: "affective/anxiety" disorders included any mood or anxiety disorder and "disruptive" disorders included ADHD, oppositional defiant disorder and conduct disorder. Children with a "combined" diagnosis had both "affective/anxiety" and "disruptive" disorders.

Childhood Behavioral Checklist (CBCL): Parents completed the CBCL [48] which is comprised of 20 social competence and 113 behavioral problem items. Although the CBCL generates general (i.e., externalizing, internalizing) and specific (i.e., aggression, depression, attention) behavioral scales, only general scores are presented in this study due to limited sample size and space limitations. The selected cut off point for borderline/clinically significant scores was $T = 60$. Due to the small sample size, interclass correlations on this sample were not calculated. However, the manual reports individual item intraclass correlations (ICC) are greater than 0.90. Stability of ICCs over a 3-month period is 0.84 for behavior problems and 0.97 for social competencies. Test/retest reliability is 0.89. Tests of criterion-related validity for referred/non-referred children support the validity of the instrument and normative data. The CBCL has been utilized in a number of studies of children with epilepsy [7,18,20,49].

The Children's Depression Inventory (CDI): This 27 item self report instrument [50] for 7-17 year old children and adolescents has a 3 point scale and produces a total score and five factor scores: dysphoric mood, acting out, loss of personal and social interest, self-deprecation, and vegetative symptoms. It has a solid internal consistency reliability (0.59-0.88), variable test/retest reliability (0.38-0.87), and poor discriminant validity (e.g., high false negative rate). Nevertheless, it is sensitive to change, has good normative data, and has been extensively used in children with chronic illness and developmental disorders.

The Multidimensional Anxiety Scale for Children (MASC): This 39-item self-report instrument [51] uses a 4-point scoring scale and generates a total score and four factor scores (e.g., physical symptoms, social anxiety, harm avoidance, separation anxiety). Used in children and adolescents, aged 8-19 years, psychometric properties are generally strong with internal consistency reliabilities ranging from 0.60 to 0.90 and test/retest reliabilities ranging from 0.65 to 0.93. In addition it discriminates with an accuracy of 0.74 between children with and without anxiety disorder. A total T score greater than 70 matches a generalized anxiety disorder diagnosis.

Cognition: The Wechsler Intelligence Scale for Children-Revised (WISC-III) [52] was administered to all study participants to generate Full Scale (FSIQ), Verbal (VIQ) and Performance (PIQ) IQ scores. Data collection for this study began in 1999. As a result the WISC-III was utilized and since this is a prospective study, the WISC-III was utilized at baseline and follow-up.

Language: All participants were evaluated with the Test of Language Development (TOLD) [53]. There are three forms including TOLD-2 Primary (children aged 4 to 8 years) (n = 26 CPS/CAE, 8 controls), TOLD-2 Intermediate (children aged 8 to 12 years) (n = 30 CPS/CAE, 15 controls), and TOAL (adolescents aged 12 to 18 years) (n = 8 CPS/CAE, 4 controls). The TOLD manual provides normative data and findings of studies indicating reliability and validity of the instruments [54]. The Spoken Language Quotient (SLQ) is derived from each of the subtests and was used as an independent variable in the data analyses.

Academic Achievement: The Wechsler Individual Achievement Test Screener (WIAT Screener) was administered to all participant [55]. The Screener consists of three subtests of the WIAT, Basic Reading, Mathematics Reasoning and Spelling. This measures academic achievement providing age and grade based scores for students' grades kindergarten-12 in the areas of single word reading, spelling and mathematics computation. Split half reliability for children aged 5-17 ranges from .87-.95 for Basic Reading, .74-.90 for Mathematics Reasoning and from .80-.93 for Spelling. The WIAT and WISC-III are normed on the same, representative standardization sample allowing for good comparison between IQ and achievement scores.

Data Analyses

Prior to statistical analyses, data were inspected for outliers and normality assumptions to ensure their appropriateness for parametric statistical tests. Since there were no significant differences in IQ, achievement, or language as well as psychopathology measures between CPS and CAE cohorts, we combined the two epilepsy groups. Epilepsy and control groups were classified into two groups: those with average intelligence (Full Scale IQ score of 85 or above) and those with below-average intelligence (Full Scale IQ score below 85) at baseline. None of the control children had Full Scale IQ below 85. Thus 3 diagnostic groups of subjects were obtained: children with epilepsy with below-average intelligence, children with epilepsy with average intelligence, and control children with average intelligence. These three groups of participants were compared on all demographic variables as well as measures of IQ, achievement, and language at baseline, using chi-square tests for the categorical measures and ANOVAs for the continuous measures. The two epilepsy groups were further compared on their seizure variables. Additionally, only the two epilepsy groups were compared on psychopathology variables at baseline due to the fact that we excluded the single control child who met criteria for a psychiatric disorder at baseline.

Changes in outcome measures in the three groups were examined using general linear models with repeated measures, with the outcome measures at the two time points as the dependent variables; group, interval between testing and the interaction group x interval were used as the predictors. The significance of the interaction term was used to ascertain whether the groups differed in changes in their scores over time. For the change in rate of psychiatric diagnosis over time, generalized linear mixed regression models were estimated, using PROC GLIMMIX in SAS v9.2.

Within the two epilepsy groups, we determined if the seizure variables at baseline were predictive of the change in outcome measures. The seizure variables that were used as predictors included age of onset (i.e., before or after age 6), poor seizure control (i.e., > 5 seizures in year prior to participation in the study) and the number of AEDs (subdivided into no AEDs, monotherapy, and polytherapy). General linear models with repeated measures were used, with each of the seizure variables, the interval between testing and the interaction term between the seizure variable and interval as predictors. Since only 3 of the epilepsy subjects of average intelligence and 2 of the epilepsy subjects with below average intelligence were not on AEDs at baseline, these subjects were deleted from these analyses.

In order to see if changes in seizure variables (seizure control and AED use) predict change in outcome measures, we first examined the change in these seizure variables. For seizure control, 15 subjects had seizures that were controlled at baseline and follow-up, 21 had seizures that were not controlled at baseline but were controlled at follow-up, 14 had seizures that were controlled at both time points and 4 had seizures that were controlled at baseline but not controlled at follow-up. In order to conduct analyses, we formed two groups as those who exhibited no change in seizure control (N=29) and those who improved in their seizure control (N=21). The 4 subjects who deteriorated in their seizure control were not used in these analyses. We then estimated general linear models with repeated measures for each of the outcome measures, with seizure change group as described above, the interval between testing and the interaction term between seizure change group and interval as predictors. For AED use, 13 of the epilepsy subjects used less AEDs at follow-up compared to baseline, 10 subjects used more AEDs at follow-up compared to baseline and 41 of the epilepsy subjects did not change in their AED use. We, therefore, did not conduct any analyses with change in AED use due to lack of statistical power.

Results

Group Characteristics

There were 23 children with epilepsy in the below average intelligence group, 41 children with epilepsy in the average intelligence group, and 27 control children in the average intelligence group. There were no significant differences in the follow up interval between the three groups ($F(2, 90) = 0.68, p = 0.51$). The children with epilepsy in the average intelligence group were significantly younger than the control children ($t(66) = 2.39, p = 0.01$). Additionally, as evident in Table 1, there were no significant differences between the two epilepsy groups based on seizure variables.

Baseline and Follow-up Comparisons of IQ, Language, and Achievement

Table 2 displays IQ, language, and achievement test scores at baseline and follow-up for all three groups—epilepsy-below average, epilepsy-average, and controls-average. As expected at baseline, significant differences on FSIQ, PIQ, VIQ, language (SLQ), and academic achievement scores were identified (See Table 2). Further, at baseline, posthoc testing demonstrated that children with epilepsy in the below average group performed below children with epilepsy in the average group and control children across all domains assessed ($t(88) = 5.88-11.92$, all p 's < 0.0001). At baseline, there were significant differences between children with epilepsy in the average group and the control children in the following domains: FSIQ ($t(88) = 2.94, p = 0.004$), VIQ ($t(88) = 2.77, p = 0.007$), SLQ ($t(86) = 2.04, p = 0.04$).

For IQ, language and academic performance, there was no significant effect of group by interval comparing the children with epilepsy in the below average group, average group, and control children for the following scores: FSIQ ($p = 0.93$), PIQ ($p = 0.78$), VIQ ($p = 0.96$), SLQ ($p = 0.85$), Reading ($p = 0.54$), Math Reasoning ($p = 0.89$), Spelling ($p = 0.65$), and Total Composite ($p = 0.84$).

Baseline Seizure Variables as Predictors of Change in IQ, Language, and Achievement

Among the children with epilepsy in the average group those who did not have seizure control at baseline (more than 5 seizures per year) were significantly more likely to demonstrate a decline in FSIQ and PIQ over the interval ($F(1, 36) = 4.33, p = 0.04$; $F(1, 37) = 4.38, p = 0.04$) than those with seizure control. Children with epilepsy in the below average group were more likely to improve on WIAT Composite ($F(1, 12) = 3.42, p = 0.05$) and WIAT Reading at follow-up if taking more than one AED at baseline ($F(1, 12) = 11.46, p = 0.005$). No baseline seizure variables predicted changes in language performance at follow-up.

Change in Seizure Variables as Predictors of Change in IQ, Language and Achievement

Among the children with epilepsy in the average group, WIAT Math performance declined over the interval in the 21 children whose seizure frequency was improved at follow-up ($F(1, 30) = 4.50, p = 0.04$) compared to the 29 children with no change in their seizure frequency. However, the change in seizure frequency was not significantly related to change in IQ and language.

Baseline and Follow-up Comparisons of Psychopathology in Children with Epilepsy

Figure 1 provides the percentage of DSM-IV psychiatric diagnoses at baseline in children with epilepsy. Children with epilepsy in the below average and average groups did not significantly differ in terms of the rate ($p = 0.52$) and type ($p = 0.49$) of psychiatric diagnoses at baseline. On the CBCL children with epilepsy in the average group had significantly higher scores (i.e., better skills) in total social competence ($t(57) = 3.81, p = .0003$), activities ($t(60) = 1.95, p = .05$), and school social competence ($t(60) = 4.07, p < .001$) compared to children with epilepsy in the below average group (Figure 2). There were no significant differences found in the CBCL Total Score ($p = 0.20$), Internalizing ($p = 0.18$), or Externalizing subscales ($p = 0.47$) (Figure 3). In addition at baseline, there were no significant differences between the two groups in scores on the MASC ($p = 0.07$) or CDI ($p = 0.87$) (Figure 3).

At follow-up children with epilepsy in both groups did not differ significantly in terms of the rate or type of psychiatric diagnoses ($p = 0.13$) (Figure 1). There was no significant difference in the change in the rate of psychiatric diagnosis, comparing children with epilepsy in both groups and control children ($F(2, 76) = .43, p = 0.65$). On the CBCL, children with epilepsy in the average group improved in their total social competence ($F(2, 84) = 4.21, p = 0.02$) and activities scores ($F(2, 86) = 4.84, p = 0.02$) while the children with epilepsy in the below average group and the control children did not change significantly over time (Figure 2). There were no significant differences found in the Total Score ($p = 0.94$), Internalizing ($p = 0.92$), or Externalizing subscales ($p = 0.88$). Children with epilepsy in the average group had a significant decrease in the total score on the MASC ($F(2, 79) = 3.27, p = 0.04$) compared to children with epilepsy in the below average (Figure 3). No significant differences were found for the change in CDI scores ($p = .92$).

Baseline and Change in Seizure Variables as Predictors of Change in Psychopathology

On the CBCL, children with epilepsy in the below average group who started having seizures prior to age 6 were more likely to have an increase in their Social Competence score at follow up ($F(1, 14) = 5.61, p = 0.03$). Additionally, children with epilepsy in the average group were more likely to have an increase in their social competence score at follow-up if they were on more than one AED at baseline ($F(1, 31) = 4.01, p = 0.05$). Baseline seizure variables were not predictors for outcome of DSM-IV diagnoses, CDI total score or MASC total score. Seizure variables at follow-up were not significant predictors for outcome of DSM-IV diagnoses, CDI total score, MASC total score or CBCL.

Discussion

This is the first study to examine the short-term outcomes of the cognitive, linguistic, academic achievement, and psychopathology comorbidities of children with chronic epilepsy with average and below average IQ compared to healthy control children. The findings are notable for their remarkable stability over the two-year interval in all three groups. In addition, baseline seizure variables and change over the follow-up interval appear to play a role in the IQ and math achievement scores of children with epilepsy with average IQ and in the reading achievement scores of those with below average IQ. However, for the most part, seizures

variables at baseline and follow-up were not predictors of DSM-IV diagnoses, depression, anxiety or behavioral problems.

At follow-up, there was no significant effect of time for each of the three groups on IQ, academic performance, and language. In a new onset sample Hermann et al. [36] reported similar findings in which there was also no significant group by time effect in intelligence, academic achievement, and language. In addition, Austin et al. [6] reported no improvement or decline overtime in academic achievement in children with chronic epilepsy.

Focusing solely on children with epilepsy in both groups, seizure variables (age of onset, poor seizure control, or number of AEDs) play only a minor role. Bjorneas et al. [38] reported that children with refractory seizures were more likely to demonstrate declines in IQ scores over time. In contrast, outcome studies on large samples of children with epilepsy suggest no association of IQ with illness variables [43].

Interestingly regarding the role of AEDs on short-term cognitive outcome, Mandelbaum et al. [56] reported improvement in cognitive functioning over 12 months of AED treatment. Additionally, Fastenau et al. [31] reported academic achievement was not negatively impacted by AED use in children with new onset seizures. These findings are somewhat counter to the cross sectional and prospective literature that indicates that AEDs generally impact cognitive functioning [26,57].

There was an unanticipated finding that children with decreased seizure frequency at follow-up had a decline in math achievement at follow-up. In contrast McNelis et al. [13] reported that children with new onset seizures demonstrated declines in academic achievement at the 12 month and 24 month follow-up, but children without recurrent seizures improved at the 24 month follow-up.

Regarding CBCL scores, Austin, Dunn, & Huster [49] followed children with epilepsy and children with asthma over 4 years. Both groups improved in internalizing problems while externalizing problems remained stable over the interval. The children with asthma had fewer behavior problems at baseline with most scores reflecting the population norms at follow-up. However, children with epilepsy had scores 1 standard deviation above the population norms both at baseline and follow-up, indicating continued significant behavioral problems. Additionally, in contrast to our unexpected findings related to improved social competence in children with early onset seizures as well as AED use, Berg et al. [19] reported that AEDs were associated with lower school competence and total competence scores.

Several short-term studies on smaller samples have not confirmed the association over time of psychopathology with seizure severity [36,58], and others have demonstrated an association with recurrent seizures [8]. These inconsistencies across studies are further illustrated by Ostrom et al.'s [37] report, contrary to their prior findings [10], that children with new onset epilepsy, who were no longer having seizures, continued to have more behavior problems at a 3.5 year follow-up. From a methodological perspective, these discrepant findings highlight the need for more long-term studies on larger samples of children to determine the relationship between severity of epilepsy and psychopathology over time in pediatric epilepsy. In addition in future longitudinal studies, it will be important to examine family factors, including parenting, family stress and family competence, to understand the impact of these factors on cognition, academic achievement, and psychiatric aspects of children with epilepsy [12]. This study's findings have several important clinical implications. First, children with epilepsy, irrespective of IQ, do not appear to do worse over time but remain stable. The children with epilepsy also did not appear to "catch up" to their peers but remained on a trajectory similar to findings reported by Ostrom et al. [37] in new onset seizures and by Baillet and Turk [7] in children with chronic and new onset epilepsy. Secondly, children with epilepsy consistently

have high rates of psychiatric disorders and behavior problems, and these elevated rates remain elevated over time [49]. These prospective findings emphasize the importance of identifying areas of underperformance and psychiatric disorders early in order to help optimize functioning, reduce any negative impact of poor academic achievement and psychiatric comorbidities on the child, and ultimately, improve the overall quality of life of the child and family [59]. Early detection is particularly important as Hermann et al. [36] found that psychiatric comorbidities were the primary predictors of academic underachievement and impaired cognitive performance at baseline and two-year follow-up. In addition, psychiatric disorders left untreated are related to poor academic achievement [60] and will impact life outcomes of children with epilepsy well into adulthood [16,61,62].

In terms of the study's limitations, the sample size limits our ability to examine epilepsy specific variables in the two different seizure types. Additionally, regarding the change in seizure variables, the findings are somewhat limited by the fact that we examined seizure frequency and number of AEDs in relatively small subgroups. Notably, the retest interval was short and restricts our ability to identify long-term changes over time. However, these limitations aside, we were able to prospectively compare a group of children with chronic epilepsy to healthy community controls and identify potential risk factors. Our findings of a fixed trajectory for the comorbidities of pediatric epilepsy provide evidence supporting the importance of screening children with epilepsy, irrespective of IQ, for problems in cognition, academic achievement, language, and behavior. Continued risk for these complications underscores the importance of earlier identification of problem areas to ultimately improve life outcomes for these children and their families.

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Figure 1. Baseline and Follow-up DSM-IV Diagnoses for Epilepsy Below Average and Epilepsy Average Groups

Figure 2. Baseline and Follow-up CBCL Social Competence Subscales for Epilepsy Below Average and Epilepsy Average Groups

Baseline: * $t(57) = 3.81, p = .0003$, ** $t(60) = 1.95, p = .05$, *** $t(60) = 4.07, p < .001$

Follow-up: ^ $F(2, 84) = 4.21, p = 0.02$, ^^ $F(2, 86) = 4.84, p = 0.02$

Figure 3. Baseline and Follow-up MASC, CDI, CBCL for Epilepsy Below Average and Epilepsy Average Groups
 Follow up: *F (2, 79) = 3.27, p = 0.04

Table 1

Characteristics of Children with Epilepsy-Below Average, Epilepsy-Average, and Control-Average at Baseline

	Epi-Below Average	Epi-Average	Control-Average
Number	23	41	27
Age (Mean, SD)	9.95 (1.78)	9.08 (2.29)*	10 (2.08)
Gender (n, %)			
Male	12 (52.17)	20 (48.78)	12 (44.44)
Female	11 (47.83)	21 (51.22)	15 (55.56)
Socioeconomic Status (n, %)			
High	5 (21.74)	15 (36.59)	9 (33.33)
Low	18 (78.26)	26 (63.41)	18 (66.67)
Ethnicity (n, %)			
Caucasian origin	13 (56.52)	21 (52.50)	13 (48.15)
Non-Caucasian origin	10 (43.48)	19 (47.50)	14 (51.85)
Follow-up Interval in months (Mean, SD)	24.3 (6.51)	22.5 (6.94)	22.6 (5.79)
Seizure Variables			
Onset (years)	6.10 (2.80)	5.94 (2.77)	
Duration (years)	3.87 (2.36)	3.14 (2.50)	
AEDs (n, %)			
No Meds	2 (8.70)	3 (7.32)	
Monotherapy	14 (60.87)	28 (68.29)	
Polytherapy	7 (30.43)	10 (24.39)	
Seizure Frequency (n,%)			
>5 per year	16 (72.73)	25 (62.50)	
<5 per year	6 (27.27)	15 (37.50)	
Prolonged seizures (n, %)			
Yes	6 (26.09)	12 (29.27)	
No	17 (73.91)	29 (70.73)	
Febrile Seizures (n, %)			
Yes	2 (8.70)	5 (12.50)	
No	21 (91.30)	35 (87.50)	
CPS (n, %)	15 (65.22)	24 (58.54)	
CAE (n, %)	8 (34.78)	17 (41.46)	

* (t(66) = 2.39, p = 0.01)

Baseline and Follow-up Outcomes of Cognition, Achievement, and Language

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