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Factors Associated with Academic Achievement in Children with Recent-Onset Seizures

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Abstract

Children with chronic epilepsy are more at risk for achievement problems than either children without seizures or children with other chronic disorders. Factors that lead to such problems in children with epilepsy, however, are not well understood. Exploring these factors is important because academic underachievement can lead to poor social outcomes and contribute to underemployment or unemployment in adulthood. This descriptive, cross-sectional study investigated a group of children who had been diagnosed with seizures approximately 12 months previously, providing the opportunity to describe relationships among family and child characteristics; parent, child, and teacher responses; and child academic achievement at the same point in time across the sample. Seventy-two children had standardized test total battery scores, 101 had a teacher's rating of performance, and 67 had scores for both. Data were analyzed using multivariate regression. Child adaptive competency and seizure severity were associated with higher teacher ratings of academic performance ($\beta = 2.38$, $p = 0.0182$ and $\beta = 0.73$, $p < 0.0001$, respectively). Child adaptive competency was associated with higher total battery scores ($\beta = 0.73$, $p < 0.0001$). Contrary to findings in studies of children with chronic epilepsy, mean academic achievement in this sample of children with recent-onset seizures was in the average range; however, 25% of the children were at or below one standard deviation below the mean on the teacher's rating of performance and 10% on the total battery. It is therefore important for health professionals and educators to regularly assess the child's academic functioning and school performance to identify those at risk for problems. Health professionals and educators need to collaborate on assessment and interventions to help maximize child academic success.

Keywords

children; seizures; academic achievement; school performance

Children with chronic epilepsy have been shown to be more at risk for learning and academic achievement problems in school than either children without seizures or children with other chronic disorders, such as asthma [1-5]. Factors that lead to these school problems in children

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with epilepsy, however, are not well understood [6,7]. An inherent problem with previous studies is that they were often conducted several years after the onset of seizures, thereby overlooking potentially important information about the trajectory of academic performance. In many studies, the time between onset of seizures and when academic skills were assessed varied considerably within the sample, making it difficult to explore when academic problems began or how family and child psychosocial factors were related to academic achievement. No reported studies have investigated academic performance in children with recent-onset seizures, although such a sample could yield data important to guide intervention and prevention efforts.

This descriptive, cross-sectional study examined a group of children who had been diagnosed with seizures approximately 12 months previously, providing the opportunity to describe relationships among family and child characteristics; child responses; and child academic achievement at the same point in time across the sample. Because this is a population that has been understudied and about which relatively little is known, we did not hypothesize effects of these factors on the outcome variables; rather, the intent was to describe relationships in this unique sample.

Background

The Double ABCX Model of Family Adjustment [8] was used as a source theory for the study. This model has been used in prior research by Austin and colleagues to help explain psychosocial factors related to adjustment in children with epilepsy and asthma [9,10]. The model considers adaptive resources and perceptions of or responses to a chronic health condition as factors in adaptation to the condition. Relevant to the current study, included in adaptation is the degree to which a child performs satisfactorily in school and is able to meet the demands of the academic environment. The theoretical model used in this study (Figure 1) combined factors from the Double ABCX model and other variables from the literature shown to be associated with academic achievement in epilepsy; however, the degree of proximity of these variables to child academic achievement was not hypothesized. We considered both illness and psychosocial factors in determining their relationships to academic achievement in a group of children with recent-onset seizures. The etiology of achievement problems is likely the result of many variables. Among those, the variables most relevant to this study include family characteristics (socioeconomic status and family resources), child characteristics (illness characteristics, age, gender), and child responses (attitude toward illness, school self-concept, adaptive competency, and internalizing behavior).

Family Characteristics measured in this study were socioeconomic status (SES) and family resources. In the general population, SES is strongly associated with educational accomplishments and attainment in children [11,12]. Verna and Campbell [13] found that SES had an indirect influence on achievement in gifted children since high-SES families have the financial capital to provide intellectual resources that can promote achievement [13]. Specific to epilepsy, but not to achievement, Mitchell et al. [3] found that level of parental education was among the best SES predictors of IQ in a group of 78 children with epilepsy. *Family resources* appear to play an important role in buffering the untoward effects of epilepsy on child academic achievement. Austin [10,14] found in a study of family characteristics of children with epilepsy and behavior problems that children with the most problems came from families with low family mastery.

Child characteristics, including illness variables, age, and gender, have been studied in relation to academic underachievement in children with epilepsy in past studies, but findings have been mixed. Longer duration of the condition [15], higher seizure frequency [15-18], and younger age at onset of seizures have been associated with higher rates of academic underachievement

[19-21]. Huberty, Austin, Risinger, and McNelis [22] and Mitchell and colleagues [3], however, found no relationship between seizure variables and achievement in children with epilepsy. Younger age at onset of seizures has been associated with higher rates of academic underachievement [19,21,23-25]. Older children were found to be further behind in their achievement levels in word recognition, spelling, arithmetic, and reading comprehension than younger children [20]. Bailet and Turk [26], however, found no relationship between age at onset and neurocognitive scores. Gender differences also have been found, with some studies reporting better adaptation and academic achievement for females than for males with epilepsy [2,27]. In a recent study of children with chronic epilepsy, Austin et al. [10] also found that males were more at risk for academic underachievement than females. In the Howe and colleagues [28] study, however, adolescent males both with and without neurological conditions scored significantly higher on the knowledge subscale of the Woodcock-Johnson Psychoeducational Battery than adolescent females. Finally, studies by Matthews, Barabas, and Ferrari [29]; Williams et al. [17]; and Rutter et al. [4] found no differences in the achievement of children with seizures based on gender.

Child response variables, including attitudes toward the illness, school self-concept, adaptive competency, and internalizing behavior problems, were hypothesized in the model to be associated with academic achievement. Austin and colleagues [10] found that children's negative attitudes toward their condition were significantly related to poorer academic achievement both in children with epilepsy and in those with asthma. Mboya [30] found that a positive global self-concept and, more strongly, a positive self-concept of academic ability were significantly related to academic achievement. Although this finding is consistent with the theory that students' perceptions influence the direction, strength, and persistence of their achievement behaviors [31], the correlation study could not show causal directions. Only two reported studies have examined school-related perceptions in children with epilepsy, and neither of these included children with recent-onset seizures. Compared with matched samples of children with diabetes or healthy controls, children with epilepsy had significantly poorer self-concepts related to intellectual functioning, were more worried about testing in school, and were more nervous about having a teacher call on them [32]. Moreover, the parents of the children with epilepsy reported that their children had fewer positive feelings about school compared to the other two groups.

The relationship between behavior problems and underachievement has been strong across research studies. Rapport, Denney, Chung and Hustace [33] found that internalizing problems, particularly anxiety/depression and withdrawal, contributed to prediction of children's classroom performance. Several studies have shown withdrawal to be related to lower academic ratings in first and second grade [34] and to lower scores on standardized achievement tests [35]. Related to this, Austin and colleagues [10] found that teachers' ratings of poorer school adaptive competency (i.e., how hard the child is working, appropriate behavior, overall happiness, and how well the child is learning) were significantly associated with poorer academic achievement in children with epilepsy.

Purpose

Although these associations have been studied in the past, the samples were general population children or children with chronic conditions. Therefore, the purpose of this study was to identify the association of these selected variables to academic achievement in children with recent-onset seizures. The overall research question was, “What family characteristics (socioeconomic status and family resources), child characteristics (illness characteristics, age, gender), and child responses (attitude toward illness, school self-concept, adaptive competency, and internalizing behavior) are related to child academic achievement?”

Methods

Research Design

Data presented are from a larger study of adaptation to childhood epilepsy in 106 children ages 8-15 years, 57 males and 49 males. Data collected at one year after onset of the first seizure were used for the current study. We chose to use 12-month data because the period immediately after the first seizure typically involves months of diagnostic assessment and adjustment. The children's conditions have stabilized fairly well by one year, making that a good time to measure how they are performing academically. We wanted the teachers' ratings and the standardized test scores to reflect a stable but early stage of the child's seizure condition. Data were collected through structured telephone interviews with each parent and child and mailed questionnaires to teachers.

Participants were children with recent-onset seizures and their major caregiving parent (72 children had total battery scores, 101 had a teacher's rating of performance, and 67 had scores for both). See Table 1 for a description of the sample. To be included in this analysis, children had to meet the following criteria: (a) between the ages of 8 and 15 years; (b) 12 months since first recognized seizure-like episode; (c) no other chronic medical conditions requiring long-term care, such as diabetes; (d) parent report that child was not mentally handicapped or school records documenting normal intelligence; and (e) no sibling with a chronic medical condition. The children were recruited from emergency rooms, outpatient pediatric clinics, private neurologists, and EEG laboratories at two sites: Indianapolis, IN, and Memphis, TN.

Instrumentation

Family Characteristics—Socioeconomic status (SES) was collected from the mother and measured using a method that combined mother's education and the occupation of the head of the household to create one score [36]. This measure has been found to be a valid and reliable indicator of SES in the prediction of health behavior [9]. A higher score represents higher SES, and the mean for this sample of 61.1 represents an average or mid-range score. Family resources were measured using selected items from the Family Inventory of Resources for Management (FIRM) [37]. The original FIRM was a 69-item self-report instrument that provided information on the family's repertoire of resources in four areas: Esteem and Communication; Mastery and Health; Extended Family Social Support; and Financial Well-Being. Items selected for the current study were from the Mastery and Health subscale, which measures personal, family system and social support resources. Parents responded to 20 items on 4-point scales of 0 (*not at all*) to 3 (*very well*). Validity and reliability have been strong in previous research, and subscales of the FIRM have been correlated with changes in child behavior. The Mastery and Health subscale showed strong internal consistency reliability in this study (coefficient alpha = .95).

Child Characteristics—Preliminary analyses showed no correlations between duration of condition, seizure frequency, or age of onset of seizures and the outcome variables, so these variables were not included in the model. The illness characteristic used was seizure severity and was calculated to categorize the children with seizures into three groups: one seizure, controlled seizures, and uncontrolled seizures. Children were placed in the one-seizure group if they had experienced only one seizure and had not been placed on medication (n = 20). Children in the controlled group had experienced one seizure, had been placed on medication (s), and had had no further seizures (n = 15). The children in the uncontrolled seizure group had experienced more than one seizure. This group included children regardless of their medication status (n = 71). This grouping provides the severity ratings used in the analyses, ranging from 1 (least severe) to 3 (most severe). The seizure information, as well as the child's age (to nearest month) and gender, were collected from parents and medical records. Although

it was recognized that medications could affect some of the variables, the large number of combinations of therapeutic level, dosage, type, and duration of medications precluded consideration of them in the model. Moreover, bivariate correlations between medications and outcome variables were not statistically significant.

Child Response—Variables selected to reflect child response were attitude, school self-concept, internalizing behavior problems, and adaptive competency. Child attitude was measured using the Child Attitude Toward Illness Scale (CATIS) [38]. The CATIS is a 13-item scale providing information on how children feel about having a particular health condition. Children responded to 9 statements on 5-point scales of 1 (*never*) to 5 (*very often*) and 4 statements on 5-point scales such as 1 (*very fair*) to 5 (*very unfair*). The scale had good reliability (alpha = .81) in this study. A total score was used in the analyses, with higher scores representing more positive attitudes. School self-concept was measured using a 17-item subscale of the Piers-Harris Self-Concept Scale (PH) [39]. Children were asked to respond "yes" or "no" to items related to intellectual and academic tasks, including general satisfaction with school and future expectations, with higher scores reflecting higher self-concept. The scale had good reliability (alpha = .78) in this study.

Child internalizing behavior was measured using the parent's report from the Child Behavior Checklist (CBCL) [40]. For each item, parents used 3-point scales from 0 (*not true*) to 2 (*very or often true*) to indicate how true each behavioral description had been for the child over the past six months. The CBCL provides separate scores for the subdimensions of internalizing and externalizing behavior, as well as for total problems. The internalizing behavior score used in the analyses reflects problems within the self, such as anxiety, depression, somatic complaints without a known medical cause, and withdrawal [40], with higher scores representing more problems.

Child adaptive competency was measured using teachers' ratings from the Teacher's Report Form (TRF) [41]. For each item, teachers used 7-point scales from 1 (*much less*) to 7 (*much more*) to indicate how true each description is for the child compared to typical pupils of the same age. The total adaptive competency score measures the child's overall happiness, how well the child is learning, appropriate behavior, and how hard the child is working at school. Higher values reflect more competencies or adaptive functioning.

Child Academic Achievement was measured using two methods: the teacher's rating of performance (TRP) and a school-administered standardized achievement test total battery score (TB). The TRP was collected using the Teacher's Report Form [41]. This score is based on the teacher's ratings of classroom performance in six academic subject areas on a scale from 1 (*far below grade level*) to 5 (*far above grade*) and summed to create a total score that reflects overall performance. Baseline school performance was obtained prior to the onset of the health condition. Follow-up data were obtained from the child's current teacher at 12 and 24 months. The norm for the TRP is a standard T-score of 50 and standard deviation of 10.

TB scores from school-administered standardized tests completed by the children during the academic year at school were used. Although different standardized tests were utilized by the various school systems, the majority used one of the following: the Indiana Statewide Testing for Educational Progress (ISTEP), the Comprehensive Test of Basic Skills (CTBS), the Iowa Test of Basic Skills (ITBS) or the California Achievement Tests (CAT). The content of these types of school-administered achievement tests are similar across grades and the scores tend to be highly correlated. Additionally, because these tests are nationally normed and based on a normal distribution, direct comparability is allowed. The tests provide information about specific academic skills and reflect the curriculum used in the schools. The tests include measures of basic academic skills, such as reading, language, and math, as well as a total

composite score (total battery) that is an overall measure of achievement. It is the latter score that was used in analyses. The norm for the total battery is a standard T-score of 50 and standard deviation of 10. The TB, like the TRP, also reflects overall academic performance; however, it is less subjective than the teachers' ratings of performance. The percentiles for the TB scores were converted to standard T-scores with a mean of 50 and standard deviation of 10, using national norms because parametric statistics are not appropriate methods of analysis for percentile data. Because of the restricted testing schedule in schools (children do not undergo testing at every grade level), not all children have test results at all times.

Data Analyses and Results

The primary analysis was a multivariable regression of nine variables: age, gender, seizure severity, SES, FIRM mastery and health, CATIS, Piers Harris school self-concept, CBCL internalizing problems score, and the adaptive functioning score, on the teacher's rating of academic performance. Descriptive statistics for these variables are shown in Table 1. These variables accounted for a moderately large amount of the variance in teachers' ratings of achievement (adjusted $R^2 = 0.529$).

Academic performance was significantly associated with seizure severity ($p=0.0182$) and the adaptive functioning score ($p < 0.0001$). The beta for seizure severity is positive, indicating that children with a more severe seizure condition do better on the teachers' ratings of achievement. This appears to be a result of low TRP scores for the group of children with a seizure severity score of 2. The mean academic achievement score for children with a severity of 2 is 45.13 with a standard deviation of 10.51. Seven of these 15 children scored at or below one standard deviation below the national mean on the teacher's rating of performance. The mean TRP for children with seizure severity of 1 is 49.65 with a standard deviation of 7.22, and for children with a severity of 3 the mean is 48.91 with a standard deviation of 9.91. The sample sizes for this analysis were small ($n = 13$, 8, and 51 for the 3 severity groups, respectively), so cautious interpretation is recommended. The beta for adaptive functioning is also positive, which indicates that higher child adaptive functioning is associated with higher teacher ratings of academic performance. The result of this regression analysis is shown in Table 2.

As a secondary analysis, multivariable regression was done on the children's total academic battery test scores. A fair amount of the variance in the Total Battery scores was explained by these nine variables (adjusted $R^2 = 0.362$). The adaptive functioning score was significantly associated with battery scores ($p < 0.0001$). Children with higher adaptive functioning performed better on the battery. Gender and SES were borderline statistically significantly associated with Total Battery ($p = 0.0783$ and $p = 0.0800$, respectively). The trends were for children with a higher SES and females to score higher on the battery. These results are shown in Table 3.

Initial examination of the teachers' ratings of performance indicated that this sample was performing slightly below average ($M = 48.5$, $SD = 9.6$), with 28 of the 101 children (27.7%) scoring at or below one standard deviation below the national mean. In contrast, academic achievement outcomes showed that this sample was performing slightly above the national average on the Total Battery score ($M = 54.6$, $SD = 11.0$). Only 9 of the 72 children (12.5%) scored at or below one standard deviation below the national mean.

Analyses were conducted on the subsample of children who scored at or below one standard deviation below the mean (28 [27.8%] on the TRP and 9 [12.5%] on the TB) to explore the relationships among variables in the low-achieving students. On the TRP, scores for this subsample ranged from 35 to 40, with 13 (12.9%) scoring 35. The subsample on the TB had scores ranging from 27 to 40. Of the 67 children who had both achievement scores, the average

difference between the Total Battery and teachers' ratings scores was 5.31, which is approximately ½ standard deviation of difference between the two measures of achievement. Overall, the teachers' ratings were slightly lower than the standardized achievement score. Additionally, the Total Battery score and the teachers' ratings of performance were moderately well correlated ($r = 0.65$, $p < 0.0001$) for the total sample. Therefore, teachers' ratings were used in the analyses. Because the subsample size was relatively small, correlational analyses rather than regression analyses were conducted using all of the variables in the model. None of the correlations were statistically significant.

Discussion

The purpose of this study was to identify variables associated with academic achievement in children at 12 months after a first-recognized seizure. It was expected that child adaptive competency (i.e., working hard, behaving appropriately, happy, and learning) would be related to child academic achievement, and this variable was strongly correlated with both teacher ratings of performance and child performance on the total battery. This finding is important because teachers' ratings are a relatively more subjective measure of performance and the total battery is an objective standardized test, yet both are predicted by this same factor. In children with chronic epilepsy, Austin and colleagues [10] also found that lower adaptive competency was associated with poorer academic achievement. These findings support the need for assessment and intervention for children who are having difficulties in areas related to work effort, behavior, learning, and happiness. Findings also strongly suggest that teachers should be involved in the assessment and treatment of children with epilepsy. Nurses should educate teachers on the capabilities and behaviors of children with epilepsy. Moreover, nurses need to educate teachers on how their attitudes can influence performance and how to be more supportive and encouraging for children who are at risk [42].

The finding that seizure severity was strongly associated with teacher ratings of academic achievement is consistent with several studies [15-18]. In our study, a large component of severity was frequency, and past studies have shown a relationship between seizure frequency and academic problems [22,25]. Subtle changes related to the seizures and treatment that affect the child's classroom performance on a daily basis, such as fatigue, attention, and memory problems, may be identified by the more frequent teacher assessments. It might be that teacher ratings of performance are more sensitive to detecting change in a child's academic performance than are standardized achievement tests, a possible explanation for why severity was not associated with total battery scores in this study. Again, the TRP measures classroom grades that reflect how the child is currently performing, so decline can be detected early.

The third major finding was that most children were performing in the average range on both the teacher ratings of performance and the school-administered standardized achievement total battery tests. This finding is similar to Williams and colleagues' [43] study in which children with controlled epilepsy were found to have verbal IQ, academic skill development, and verbal memory skills within the average range. Similarly, Austin, Huberty, Huster and Dunn [44] found that the achievement of children with inactive or low-severity epilepsy was comparable to national norms. So while children with epilepsy are at risk for academic problems, findings from this study indicate that these problems, in general, do not manifest within the first year following diagnosis. It should be noted, however, that there were some children who were already scoring below average on both measure of academic performance. Future studies need to follow a sample with new-onset seizures for a longer period of time to explore factors associated with poor performance, to examine change in achievement over time, and identify when academic problems develop.

Also important was the finding that teacher ratings of performance and the total battery scores were significantly correlated. Standardized testing is not completed at each grade level in school, and this finding shows that teacher ratings can be used as a fairly reliable measure of academic performance when standardized scores are not available. Moreover, teachers can make frequent assessments and closely monitor changes in performance using the TRP, whereas standardized testing in the school does not occur often enough to identify these changes.

Limitations of the study include potential confounding of data collected from the teachers on ratings of academic performance and adaptive functioning; however, the standardized test scores reduce the concern because those are not assessed by the teacher. Additionally, the use of standardized achievement test scores may not accurately reflect overall academic functioning nor illuminate specific strengths and weaknesses of the child. Numerous factors affect how well a child performs on standardized tests, including fatigue, illness, and stress. Because these tests essentially measure performance on the day of testing, the teacher ratings, which reflect performance over time, may be a more reliable measure on which to base interventions. The disadvantage to using school-administered standardized tests is the infrequency of measurement. In our study, almost a third of the children did not have total battery scores, limiting the strength of data analysis, particularly when seizure severity was used. The failure to include epilepsy syndromes in analyses is also a limitation of the study. Huberty and colleagues [22] have suggested that the relationship between epilepsy and achievement might be better understood if examined using syndromes in addition to seizure severity. Lastly, the cross-sectional data precluded causal inferences. Longitudinal and multietiological studies are needed to examine causation.

Implications for health care professionals working with children who have seizures include regular assessment of the child's academic functioning and school performance. Academic underachievement is often not identified or discussed and is often overridden by more pressing medical problems associated with the disorder; however, it may be a significant problem for the child and family. Findings from this study justify using psychosocial and educational assessments for identifying children with epilepsy who may be at risk for academic achievement problems. Because of the strong findings related to child adaptive competency, further investigation is needed to identify interventions to improve work effort, behavior, overall happiness, and how well the child is learning.

Teacher involvement in ongoing assessment and intervention to promote child achievement is essential for success. The development of a multidisciplinary collaborative program is necessary to deliver appropriate services for children with seizures. Open communication and collaboration between medical and school professionals is required to meet the special needs of children with epilepsy, with emphasis on training school teachers and administrators to assess the impact that seizures and medications have on classroom performance and interventions to undertake when problems arise. Coordination between medicine and education will enhance the learning environment and lead to interventions that maximize the child's ability to succeed.

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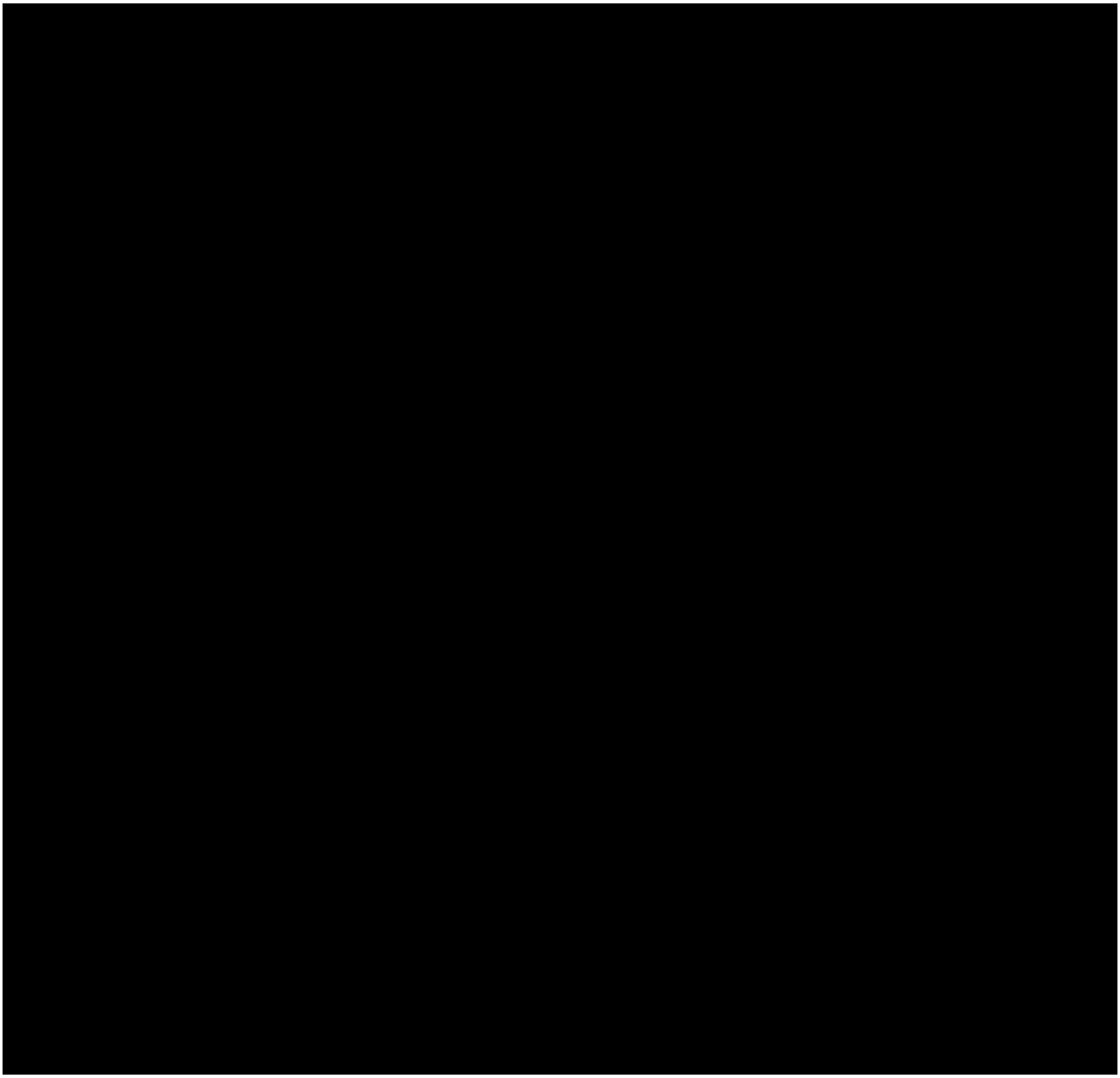

Figure 1.
Predictive Model of Academic Achievement in Children with Seizures

Table 1

Descriptive Statistics

	N	Min	Max	Mean	SD
SES	101	16.4	82.2	61.30	11.70
FIRM Mastery and Health	106	0.22	3	2.04	0.61
Age	106	8.14	15.82	11.26	2.30
Child Attitude Toward Illness Scale	101	1.85	5	3.72	0.62
Piers Harris Self-Concept School subscale	101	5	17	14.20	3.23
CBCL Internalizing Problems	106	31	76	52.70	10.76
Adaptive Functioning	98	35	65	47.23	8.34
Teacher's Rating of Performance	101	35	65	48.5	9.6
Total Battery Score	72	27	73	54.6	11.0

Table 2

Predicting Teacher's Rating of Performance

	β	t	p-value
Age	−0.06	−0.18	0.8554
Female	−0.61	−0.41	0.6851
Seizure Severity	2.38	2.41	0.0182
SES	0.10	1.55	0.1262
FIRM Mastery and Health	−0.38	−0.29	0.7713
Child Attitude Toward Illness Scale	0.51	0.36	0.7170
Piers Harris Self-Concept School subscale	0.41	1.52	0.1338
CBCL Internalizing Problems	−0.03	−0.33	0.7390
Adaptive Functioning	0.73	7.95	<0.0001

Adjusted $R^2 = 0.529$

Table 3

Predicting Total Battery Score

	β	t	p-value
Age	−0.35	−0.67	0.5070
Female	4.34	1.79	0.0800
Seizure Severity	−0.11	−0.07	0.9437
SES	0.17	1.80	0.0783
FIRM Mastery and Health	2.45	1.09	0.2788
Child Attitude Toward Illness	1.68	0.72	0.4725
Piers Harris Self-Concept School subscale	0.56	1.18	0.2439
CBCL Internalizing Problems	0.03	0,24	0.8117
Adaptive Functioning	0.73	4.60	<0.0001

Adjusted $R^2 = 0.362$