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# Behavior and mental health problems in children with epilepsy and low IQ

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## Abstract

The purpose of this cross-sectional descriptive study was to describe the particular types of behavioral problems, self-concept, and symptoms of depression experienced by children with both low IQ and epilepsy. Three groups of children (83 males, 81 females; mean age 11 years 10 months, SD 1 year 10 months; age range 9 to 14 years) with epilepsy were compared: (Group 1) Low IQ (<85), *n*=48, 25 males, 23 females; (Group 2) Middle IQ (85 to 100), *n*=58, 24 males, 34 females; and (Group 3) High IQ (>100), *n*=58, 34 males, 24 females. The Child Behavior Checklist, Piers–Harris Self-Concept Scale, and Children's Depression Inventory were used to measure behavior, self-concept, and depression respectively. Results indicated that children in the Low IQ group had the most behavioral and mental health problems. Additionally, there were IQ group-by-sex interactions, with females in the Low IQ group being at the highest risk for poor self-concept. Findings suggest that children with both epilepsy and low IQ should be carefully assessed for mental health problems in the clinical setting.

Children with chronic epilepsy and children with a low IQ have each been shown to be at increased risk for quality of life problems. Research studies focusing on children with epilepsy and normal IQ, or on children with mental retardation* who do not have epilepsy, show that mental retardation and epilepsy are each independently related to poor quality of life and psychosocial problems (Austin et al. 1994,1996;Lewis et al. 2000;Sabaz et al. 2001). Because each disorder is associated with such problems it is probable that children with both disorders will experience even greater problems than those with just one of the disorders. Among children with epilepsy, 28 to 38% have some degree of mental retardation (Steffenburg et al. 1996). In addition, there is an unexpectedly high number of children with both epilepsy and low IQ (70

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*UK usage: learning disability.

to 80) who do not fit the DSM-IV (American Psychiatric Association 1994) criteria for mental retardation (Dodson 2001). On average, the IQ in children with epilepsy is 10 points lower than that of their healthy, age-matched peers (Dodson 2001). Despite the strong relationship between epilepsy and low IQ, only a few studies have addressed the psychosocial and mental health problems of this population.

Epidemiological studies of children with mental retardation and epilepsy have established that there are high rates of psychopathology. Rates of psychiatric disorders range from 50 to 59% in children with both epilepsy and mental retardation (Rutter 1989, Steffenburg et al. 1996). The most common psychiatric issues include psychoses, depression attention-deficit–hyperactivity disorder, socialization problems, aberrant behavior, and autistic disorder (Gillberg et al. 1986, Steffen-burg et al. 1996, Hackett et al. 1998).

Quality of life issues and psychosocial adaptation have not been investigated extensively in this population. The few studies on institutionalized adults with both mental retardation and epilepsy indicate that psychosocial functioning is poor. Two studies compared institutionalized adults with both mental retardation and epilepsy with those with just mental retardation. Both studies included people with mild to moderate mental retardation and matched the samples by level of retardation. In both studies, residents with epilepsy displayed fewer social and adaptive skills and were less independent than those without epilepsy (Espie et al. 1989, Matson et al. 1999).

Studies addressing psychosocial problems in children with both epilepsy and mental retardation/low IQ support the hypothesis that these conditions together are associated with a lower quality of life than if only one of the conditions exists. For example, one study designed to measure quality of life in children with epilepsy and their families included, but was not limited to, children with epilepsy and low IQ. Results showed that epilepsy accompanied by additional disabilities such as mental retardation had an adverse effect on quality of life for both the child and the child's family (Hoare 1993). Two studies measured behavior problems by using the Developmental Behavioral Checklist (Einfeld and Tonge 1994). The Developmental Behavioral Checklist is a 96-item scale that provides a behavioral profile of children with low IQ. Lewis et al. (2000) studied children with low IQ to determine whether those who also had epilepsy were doing worse. Although results did not reach statistical significance, children who had active epilepsy had the highest total behavior problem scores (Lewis et al. 2000). In a study by Sabaz et al. (2001), 65% of the children with both low IQ and epilepsy scored in the clinically abnormal range compared with 41% of those with mental retardation alone. These findings demonstrate a high rate of behavioral disturbance in children with both epilepsy and low IQ. This second study also explored the children's quality of life by using the Quality of Life in Childhood Epilepsy Questionnaire (Sabaz et al. 2000) and showed that the sample with both low IQ and epilepsy had poorer health-related quality of life than the sample with normal IQ and epilepsy.

No studies were found that addressed the effect of sex of children with both epilepsy and low IQ. Studies of behavior and mental health problems in youths with epilepsy that explored sex differences reported conflicting results. In some studies females were found to be at a higher risk than males (Austin et al. 1992, 2000; McDermott et al. 1995). In contrast, Stores (1978) found males to have more behavioral difficulties than females.

In summary, high rates of psychopathology, poor psychosocial functioning, and poor quality of life have been demonstrated in the few studies that have examined this population. Only three studies have addressed issues in children with both epilepsy and low IQ and none have described self-concept levels. In addition, no study has addressed the possibility of IQ group-by-sex interactions. Further research will increase understanding of the problems of this

population so that interventions can be developed. It was the purpose of the current study to describe the particular types of behavioral problems, self-concept, and symptoms of depression experienced by children with both low IQ and epilepsy, and to explore differences based on sex.

## Methods

### DESIGN

Because of the limited information available on children with epilepsy and low IQ, a cross-sectional descriptive study design was used to provide an initial description of these children in terms of behavior, self-concept, and depression problems. The study was part of a larger research project on adaptation to epilepsy in adolescents. The larger study was approved by the Institutional Review Board. Before data collection, parents gave informed consent for themselves and for their child to take part, and the child gave informed assent to participation. Parents completed structured telephone interviews to identify behavior problems. Children completed structured telephone interviews to measure self-concept and symptoms of depression. IQ was assessed during an individual neuropsychological evaluation at approximately the same time as the mother and child telephone interviews.

### SAMPLE

One hundred and sixty-four children (83 males, 81 females; mean age 11 years 10 months, SD 1 year 10 months; age range 9 and 14 years) who had a diagnosis of epilepsy for at least 6 months were recruited through pediatric neurology clinics and from school nurses in the greater Indianapolis area. Exclusion criteria included a progressive brain disorder (such as a brain tumor), a major medical condition other than epilepsy, or placement in classes for those with mental retardation (see Table I for a description of the sample). In the study sample IQ scores ranged from 56 to 130. Participants were placed into one of three IQ groups: (1) IQ under 85 ($n$=48), (2) IQ between 85 and 100 ($n$=58), and (3) IQ above the national mean of 100 ($n$=58). For ease of description in this paper, these groups are labeled ‘low,’ ‘middle,’ and ‘high’ respectively. It should be noted that the ‘high group’ falls in the mid-average to high-average range (50th to 98th centile compared with the national standardization sample); the ‘middle group’ falls in the low-average to mid-average range (16th to 50th centile); and the ‘low group’ falls in the mild mental retardation to low-average range (1st to 16th centile).

### MEASURES

**Behavior problems—**Behavior problems were measured by the major caregiver’s (usually the mother’s) ratings of the child on the Child Behavior Checklist (CBCL; Achenbach 1991). On the CBCL, parents rate their child’s behavior on 118 items using three-point scales of 0 (not true), 1 (somewhat or sometimes true), and 2 (very true or often true). The scale has standardized normative scores for age and sex (Achenbach 1991), and in past research the scale has been found to have strong reliability and validity. The CBCL provides a Total Behavior Problem score, two second-order factor scores (Internalizing Problems and Externalizing Problems), and eight Syndrome scale scores (Aggressive Behavior, Anxious/Depressed, Delinquent Behavior, Attention Problems, Social Problems, Thought Problems, Withdrawn, and Somatic Complaints). The Internalizing Problem Score includes Syndrome scale scores of Anxious/Depressed, Withdrawn, and Somatic Complaints, and the Externalizing Problem Score includes the Syndrome scale scores of Delinquent Behavior and Aggression. Other Syndrome scales include Social Problems, Thought Problems, and Attention Problems. The CBCL has been used successfully in children with mild mental retardation (Borthwick-Duffy et al. 1997). In this study, the questions were read to the parents and answers were recorded by a trained research assistant.

**Self-concept—**Child self-concept was measured with the Piers–Harris Self-Concept Scale (PH; Piers 1984), an 80-item scale measuring children's perceptions of themselves that provides a total self-concept score and subscale scores measuring their self-reported behavior, intellectual and school status, physical appearance, anxiety, popularity, and happiness and satisfaction (Piers 1984). The PH uses a 'yes' or 'no' response scale and in this study yielded total scores ranging from 25 to 78. A trained research assistant read the PH to the child and recorded the answers. The PH is aimed at a third grade (8 year-old) reading level and has been used successfully in children with mild mental retardation (Matson et al. 1985). The coefficient alpha for the Total score was 0.92 for this sample.

**Depression—**Child depression symptoms were measured with the Children's Depression Inventory (CDI; Kovacs 1985). The CDI is a 27-item scale that measures overt symptoms of childhood depression. Children respond to each item with a rating of 0 to 2, with higher scores indicating increased psychopathology. The CDI was designed to be used in children as young as 7 years of age (Kovacs 1980) and is read to the child by a trained research assistant who also records the answers. Support for the reliability and validity of the CDI has been found in previous research (Kovacs 1980). The coefficient alpha for the scale for this sample was 0.83.

**Intelligence—**Intelligence was measured with the Kaufman Brief Intelligence Test (K-BIT; Kaufman and Kaufman 1983). During a formal individual neuropsychological evaluation, each child completed the K-BIT. The K-BIT estimates verbal and visual–spatial intellectual abilities based on one vocabulary subtest and one visual–spatial reasoning subtest. It was standardized on a national sample and is highly correlated with IQ scores on comprehensive child IQ tests. Testing was completed by a trained psychometrist under the supervision of a licensed clinical neuropsychologist (PSF). All testing was completed individually in a quiet, well-lit room as part of a more complete neuropsychological evaluation.

**Seizure severity—**Seizure severity was measured by administering a revised version of the Seizure Severity Scale for adults (Baker et al. 1991). This scale, which reflects the degree to which seizures disrupt everyday life and takes into consideration seizure type, frequency, and timing, was revised for completion by parents. Items were reworded and some items were dropped. The coefficient alpha for the final nine-item scale for this sample was 0.79.

## STATISTICAL ANALYSIS

For all statistical tests, differences were considered to be statistically significant if $p$ was less than or equal to 0.05. Statistical tests were performed with SAS software (version 8.2). First, demographic and clinical characteristics were obtained by IQ group. One-way analysis of variance (ANOVA) was used to test for mean differences for continuous variables across IQ groups. If the overall $F$-test was significant, the Tukey–Kramer method was used to test for pairwise differences. $\chi^2$ tests (or Fisher's exact test when the assumptions of the $\chi^2$ test were not met) were used to test whether or not there were significant associations between IQ group and sex, race, seizure type, or type and number of current medications (none, one, or polytherapy). For each demographic or clinical variable that was significantly associated with IQ, we tested whether that variable was significantly associated with any of the mental health outcomes. Pearson's correlation coefficients were used for continuous outcomes and logistic regression for categorical outcomes.

Means (SDs) for the outcomes were calculated by IQ group overall and by sex/IQ groups. The percentage at risk was also computed for each scale for which an 'at-risk' cut-off had been documented (all scales except the PH scales). Percentage at-risk values calculated within each sex/IQ group should be viewed with caution because of small sample sizes. However, they were calculated for ease of comparison across sex. For the CBCL Total Problem score and

second-order factor scales (Internalizing and Externalizing), the definition of at-risk is a score of 60 or higher, which is approximately 1SD above the mean of Achenbach's normative sample (Achenbach 1991), and for Syndrome scale it is a score of 67 or higher, approximately 2SDs above the mean. Thus a higher percentage of the normal population is at risk for the factors outlined in the Total Problem, Internalizing, and Externalizing scales than for the Syndrome scale (16% versus 1 to 2%, respectively). For the CDI the definition of at-risk is a score greater than 12.

For behavior and self-concept, we examined both summary scores (such as Total, Internalizing, and Externalizing scales for behavior) which provided overall outcome measures for comparison, and specific subscales (such as Withdrawn) which permitted comparisons of specific types of behaviors. Depression was examined with a single summary score. In all models described below, additional models that adjusted for demographic or clinical variables significantly associated with both IQ and mental health outcomes were also fitted for comparison purposes.

To assess whether or not IQ was related to behavior, self-concept, and depression we conducted one-way ANOVAs or analyses of covariance (ANCOVAs) to test for mean differences for continuous outcomes by IQ group. If the overall *F*-test for IQ was significant, the Tukey–Kramer method was used to test for pairwise differences. These tests were not conducted for the CBCL syndrome scales because they are truncated at a *T*-score of 50. We also tested whether there were differences in percentage at risk across the IQ groups by using logistic regression.

Finally, to examine sex interactions with IQ group, we fitted two-way ANOVA or ANCOVA models with main effects for IQ group and sex and an IQ group-by-sex interaction for continuous outcomes, and logistic regression for the at-risk outcomes, again with main effects for IQ group and sex and an IQ group-by-sex interaction. If the interaction was significant in the ANOVA or ANCOVA models, we used the Tukey–Kramer method to test for pairwise differences across the six sex and IQ groups.

## Results

Significant differences could be found between the IQ groups on several clinical factors (Table I). Mean age at onset of seizures for the High IQ group was significantly older and the mean seizure severity was significantly lower than both the Low and Middle IQ groups. Means for the Low and Middle IQ groups did not differ from each other for these characteristics. Mean seizure duration for the High IQ group was significantly shorter than the Low IQ group but not the Middle IQ group, and the Middle and Low IQ groups also did not differ from each other. There was no difference between the three IQ groups with regard to mean age of child at baseline, length of time in education for mother, age of mother, nor frequencies for the child's sex, race, seizure type, or number of current medications. An exploration of antiepileptic medications showed that the two most commonly prescribed were sodium valproate (74 of 164 children) and carbamazepine (63 of 164). However, the percentages of children receiving each of these two medications were not different across the three IQ groups (sodium valproate, $p$=0.4153; carbamazepine, $p$=0.3855).

Of the three clinical variables associated with IQ group, two of them, age at onset and duration of seizures, were not significantly associated with any of the mental health outcomes. Seizure severity was significantly associated with Total, Internalizing, and Externalizing Problems as well as with depression. Thus for comparative purposes, we fitted all models with and without adjustment for seizure severity. Results for each outcome are summarized below.

All 164 children completed at least one of the response scales. For the CBCL instrument, one female in the Low IQ group and one male and one female in the High IQ group did not complete

the instrument. For the PH instrument, one male in the Low IQ group, one male and one female in the Middle IQ group, and one male in the High IQ group did not complete the instrument. For the CDI instrument, two males in the Middle IQ group and one male in the High IQ group did not complete the instrument.

## CHILD BEHAVIOR CHECKLIST

Although not always significant, there was a robust pattern for children in the Low IQ group to have the highest mean problem scores and highest percentage at risk; for children in the High IQ group to have the lowest mean problem scores and lowest percentage at risk, and for children in the Middle IQ group to fall in between the other two.

**Total, Internalizing, and Externalizing Problems—**Mean scores and percentages at risk for Total, Internalizing, and Externalizing Problems, both overall and by sex, are presented in Table II. Children in the High IQ group had means almost 1SD above the normative means on Total and Internalizing scales. For Externalizing scales, children had mean scores closer to the normative mean. Mean scores for Total Problems and Internalizing Problems for the Low and Middle IQ groups tended to be more than 1SD above the normative mean. Although there was a clear trend for mean scores to be higher as IQ decreased for all three scales, the only difference that was statistically significant was for Total Problems ($p$=0.0055), in which the mean was higher in the Low IQ group than the High IQ group. However, there was no significant interaction with sex, and the overall mean differences were not significant at the 0.05 level after adjusting for seizure severity ($p$=0.0947).

For percentage at risk for problems, all three IQ groups had percentages at risk higher than the normative value of 16%, with the percentage at risk increasing as IQ decreased. However, the only significant difference was for Total Problems ($p$=0.0348), in which the percentage at risk was 68% for the Low IQ group, 59% for the Middle IQ group, and 43% for the High IQ group. After adjusting for seizure severity, this result was no longer significant ($p$=0.1614). There was no significant sex interaction, whether adjusting for seizure severity or not.

**Specific Internalizing Problems—**When considering specific types of Internalizing Problems, most mean scores were near or above 1SD of the normative value of 54, and percentages at risk were much higher than the normative value of 2% (Table III). For both males and females, there was a pattern for Withdrawn problems to increase on average with decreasing IQ, and a similar pattern was seen for females only for Somatic Complaints and Anxious/Depressed problems. However, there was no statistically significant difference related to either IQ group alone or the IQ group-by-sex interaction, whether adjusting for seizure severity or not.

**Specific Externalizing Problems—**Mean scores for specific Externalizing Problems were above the normative values but within 1SD of them, which is reflected in lower percentages at risk compared with specific Internalizing Problems (Table III). For both males and females there was a pattern for Aggressive Behavior Problems to increase on average with decreasing IQ, and a similar pattern was seen for females only for Delinquent Behavior Problems. However, there was no statistically significant difference related to either IQ group alone or the IQ group-by-sex interaction, whether adjusting for seizure severity or not.

**Other specific problems—**Mean scores and percentages at risk for Social, Thought, and Attention Problems are reported in Table IV. For Social and Attention Problems, mean scores tended to be more than 1SD above the normative values, with mean scores for the Low IQ group being almost 2SDs higher. In fact, percentages at risk were significantly different for Social Problems ($p$=0.0034), with the Low IQ group value being 51%, Middle IQ group 43%,

and High IQ group 20%. There was also evidence for an IQ group-by-sex interaction for Attention Problems ($p$=0.0013). As shown in Table IV, the percentage at risk for Attention Problems in males showed little variability across the three IQ groups. In contrast, for females 82% in the Low IQ group were at risk compared with 65% in the Middle IQ group and only 17% in the High IQ group. Both the main effect for Social Problems and IQ-group-by-sex interaction for Attention Problems continued to be significant after adjusting for seizure severity ($p$=0.0401 and $p$=0.0085 respectively).

### SELF-CONCEPT SCALE

For self-concept, clear trends were again evident, with the Low IQ group having the poorest self-concept scores. As shown in Table V, mean differences were significant for PH Total ($p$=0.0079), Anxiety ($p$=0.0175), Happiness ($p$=0.0016), Popularity ($p$=0.0310), and School ($p$=0.0029) scores. In all cases except one, means for the Low IQ group differed from the High IQ group at the 0.05 level of significance, but neither of these two groups had means significantly different from the Middle IQ group. The exception was for mean Happiness, where the Low IQ group was also significantly different from the Middle IQ group. After adjusting for seizure severity, PH Total ($p$=0.0182), Happiness ($p$=0.0035), and School ($p$=0.0074) remained significant and pairwise differences were unchanged, but Anxiety ($p$=0.0515) and Popularity ($p$=0.0641) were no longer significant at the 0.05 level.

Several IQ group-by-sex interactions were observed. For the Total score ($p$=0.0183) and Anxiety score ($p$=0.0426), females in the Low IQ group had significantly poorer mean scores than all of the other five groups. For Happiness ($p$=0.0326), females in the Low IQ group had significantly poorer mean scores than all other groups except males in the Low IQ group. Physical Appearance scores ($p$=0.0200) for females in the Low IQ group were significantly poorer than for females in the High IQ group and males in the Low IQ group. None of the other pairwise comparisons were significant for these four scales. These results remained unchanged when adjusting for seizure severity with $p$-values for Total Self-Concept, Anxiety, Happiness, and Physical Appearance being 0.0185, 0.0377, 0.0292, and 0.0249 respectively.

### CDI

For depression ($p$=0.0066), the mean for the Low IQ group differed from the High IQ group at the 0.05 level of significance, but neither of these two groups had means significantly different from the Middle IQ group (Table V). The percentage at risk for depression was not significantly related to IQ group at the 0.05 level of significance ($p$=0.0631). In addition, there was no significant IQ group-by-sex interaction for either mean scores or percentage at risk, although males tended to have more stable values across IQ groups and females more variability. For example, the percentage at risk for males ranged from 15 to 23%, whereas the range for females was 8 to 43%. Results remained the same after adjustment for seizure severity.

## Discussion

The purpose of this study was to describe IQ-based differences in behavior problems, depressive symptoms, and dimensions of self-concept in children and adolescents with epilepsy. Data were from an ongoing study investigating adaptation in children with epilepsy. Although none of the children had been diagnosed with mental retardation and all were in normal classrooms at the time they entered the study, some had below-average IQs. The few studies of children with epilepsy and a low IQ show that they experience high rates of behavior and mental health problems. Self-concept and symptoms of depression have not been studied in this population and it is not known whether these problems vary on the basis of IQ level or sex.

Children were placed into three groups based on IQ. The three IQ groups did not differ on any demographic variable. However, age at seizure onset, seizure severity, and duration of seizure condition varied significantly between the three IQ groups. The pattern was for the High IQ group to have seizures that were less severe and of shorter duration than the Low and Middle IQ groups. These findings are consistent with previous studies showing that earlier onset and longer duration of seizures are associated with a lower IQ (Strauss et al. 1995, Bulteau et al. 2000). Because the three groups did not differ by either type or number of antiepileptic medications, differences found between groups are unlikely to have been a result of treatment with medication.

## CBCL

**Total Behavior, Internalizing and Externalizing Problems—**The finding that children in the Low IQ group displayed the most behavior problems is consistent with past research showing that people with epilepsy and low IQ have relatively high rates of problems with behavior and mental health (Hoare 1993, Deb 1997, Espie et al. 1999, Sabaz et al. 2001). The children displayed more Internalizing Problems (anxiety/depression, withdrawal, and somatic complaints) than Externalizing Problems (delinquency and aggression). This finding is consistent with the broader literature on adaptation in children with chronic health conditions, which show that children with chronic conditions are more likely to have Internalizing rather than Externalizing Behavior Problems (Thompson and Gustafson 1996). Moreover, children whose chronic conditions involve the brain have previously been found to be especially vulnerable to Internalizing Problems (Hoare and Kerley 1991, Thompson and Gustafson 1996).

**Other behavior problems—**When specific problems were explored across the three groups, differences were found in two areas: social problems and attention problems. Children in the Low IQ group were experiencing the most social problems. Researchers have found higher rates of social problems in children with epilepsy (Hoare 1993, Mitchell et al. 1994, Wilde and Haslam 1996, Brantley et al. 2002) and in children with mental retardation (Guralnick 1997). Our findings are consistent with previous studies suggesting that low IQ is associated with more social problems (Espie et al. 1989, Sabaz et al. 2001, Adams et al. 2002). Sabaz et al. (2001) reported that children with epilepsy and an IQ score below 70 experience problems in the areas of social interactions and social activities. Children with a low IQ might miss or inappropriately read or respond to social cues. In addition, because of limited cognitive skills they might not be able to negotiate social conflict as readily as children with a higher IQ. In a similar fashion, children with mild cognitive delay display similar social interaction problems (Freeman and Kasari 1998). The two disorders might have an additive effect, causing children with both chronic epilepsy and a low IQ to experience even greater social problems.

Attention problems also have previously been reported in children with a low IQ and in children with epilepsy (Floyd and Gallagher 1997, Schoenfeld et al. 1999). The mean attention problems scores in this sample across all three groups were particularly high compared with those found in previous studies. For example, in the study by Floyd and Gallagher (1997) the mean attention score for the children with mild mental retardation was about 1SD worse than the norm, which was almost the same as the High IQ group in our study. Moreover, the Low and Middle IQ groups in our study were even worse. This finding indicates that attention problems were higher in our sample of children with both epilepsy and low IQ than in children with just mild mental retardation. One possible explanation is that there is an additive effect of the epilepsy and low IQ given that multiple neural networks affect attention. Our finding that the High IQ group had fewer attention problems even after adjusting for seizure severity suggests that IQ also might be related to attention problems.

The only significant IQ group-by-sex interaction was for attention problems. It is interesting to note that there was more variability in females than males across the three IQ groups. Females in the High IQ group had the fewest attention problems and females in the Low IQ group had most the attention problems. This high rate of attention problems in females is consistent with a previous study suggesting that adolescent females with high seizure severity are most at risk for behavior problems (Austin et al. 2000).

## SELF-CONCEPT

Although children with epilepsy have been found to have poorer self-concepts than children with other chronic disorders (Matthews et al. 1982, Austin 1989), it was not known whether self-concept varied by IQ and sex in this population. Of the seven dimensions of self-concept explored, IQ group differences were found for five and IQ group-by-sex differences were found for four. Although children with a low IQ had the poorest self-concepts, the females in the Low IQ group primarily accounted for these differences. The fact that IQ group-by-sex interactions were significant even when seizure severity was statistically controlled indicates that the differences cannot be attributed entirely to seizure severity. Research on children with low IQ alone provides some insight into these findings. One possible reason for poor self-concept in children in the Low IQ group is that they have unrealistically high expectations of themselves, which would lead to a negative self-appraisal when they did not meet those expectations (Zigler and Bennett-Gates 1999). In addition, as has been reported for children with mental retardation, children with the lowest IQs are more likely to have experienced failure in school and in social settings. Failure experiences can lead both to a poor self-concept and symptoms of depression (Zigler and Bennett-Gates 1999). In the present study, children in the Low IQ group would be the most comparable to children with mental retardation.

Another explanation for low self-concept is that children with a low IQ might have poorer coping skills. Active and purposeful problem-solving coping is related to better social adjustment and higher self-concepts (Meijer et al. 2002). Children with a low IQ might be less able to develop these effective coping behaviors. Furthermore, because the Low IQ group had more severe seizure conditions on average in the present study, they might have had to cope with more seizure-related stressors than the High and Middle IQ groups.

In a study of general population adolescents, Renk and Creasey (2003) found that adolescent females use more emotion-focused coping strategies than males. Meijer et al. (2002) showed that emotion-focused coping such as depressive reaction coping is associated with poor global self-concept in children with chronic disorders. Moreover, females in early adolescence are more vulnerable when they have any condition that sets them apart from other children (Nolen-Hoeksema et al. 1992). The sex differences found in the present study suggest that females with low IQ and epilepsy are especially at risk for poor self-concepts. Future studies should explore coping strategies and their role in the development of self-concept.

## CDI

In this sample, children with low IQ were at a greater risk for depression than those in the Middle and High IQ groups. Although, again there was a pattern for females in the Low IQ group to have the most depression symptoms, this difference was not statistically significant. These findings are consistent with past studies showing that depression is associated with epilepsy (Brent 1986, McDermott et al. 1995, Carlton-Ford et al. 1997, Dunn et al. 1999), but this concept has not been studied in children with epilepsy and low IQ. However, there is a relationship between self-concept and depression (Meijer et al. 2002). In the present study, children in the low IQ group had the poorest self-concept scores and higher depression scores. Future research should address the relationship between IQ and depression.

## Conclusion

We found that children with epilepsy and low IQ had the most behavior problems, the lowest self-concepts, and the most symptoms of depression. The significant IQ group-by-sex interactions all indicated that females with a low IQ are the most vulnerable to poor self-concepts. Although our sample sizes in the IQ groups were limited by the constraints of the ongoing study, results strongly indicate that IQ and sex are important.

Future research should explore further the mental health problems found in this population as well as the factors that might account for the IQ and sex differences we have described. A thorough exploration of the behavioral and mental health issues of children with both epilepsy and low IQ is crucial to identifying those who are most at risk for problems so they can be targeted for interventions. In addition, research is needed to provide a foundation for the development of interventions to help alleviate or prevent problems in this population. Finally, our findings suggest that children with both epilepsy and low IQ should be regularly assessed for problems in the clinical setting.

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## List of abbreviations

**CBCL**
: Child Behavior Checklist, CDI, Children’s Depression Inventory

**K-BIT**
: Kaufman Brief Intelligence Test

**PH**
: Piers–Harris Self-Concept Scale

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**Table I**

Demographics and clinical variables by IQ group

| Demographics (n=48) | Low IQ (56–84) (n=58) | | Middle IQ (85–100) (n=58) | | High IQ (101–130) | | p[b] |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | |
| Age at baseline, y | 12.02 | 1.56 | 11.58 | 1.82 | 11.81 | 1.92 | 0.4439 |
| Age at onset of seizures, y | 5.89 | 3.55 | 5.89 | 3.89 | 7.71 | 3.61 | 0.0128 |
| Duration of seizures, y | 6.16 | 3.68 | 5.69 | 4.05 | 4.09 | 3.44 | 0.0124 |
| Seizure severity[a] | 14.85 | 5.41 | 13.04 | 5.44 | 10.35 | 5.61 | 0.0002 |
| Mothers' education, y | 12.90 | 2.76 | 13.71 | 2.20 | 13.69 | 3.08 | 0.2266 |
| Mothers' age, y | 38.60 | 5.25 | 36.81 | 8.64 | 38.59 | 9.34 | 0.4033 |
| *Clinical variables* | *n* | % | *n* | % | *n* | % | |
| Male child | 25 | 52 | 24 | 41 | 34 | 59 | 0.1731 |
| Caucasian child | 43 | 90 | 53 | 91 | 54 | 93 | 0.8368 |
| Seizure type | | | | | | | |
| Absence | 5 | 11 | 8 | 14 | 10 | 18 | 0.3240 |
| Simple partial | 2 | 4 | 1 | 2 | 3 | 5 | |
| Complex partial | 17 | 36 | 11 | 20 | 18 | 32 | |
| Partial with generalization | 7 | 15 | 14 | 25 | 7 | 12 | |
| Generalized tonic–clonic | 5 | 11 | 7 | 13 | 10 | 18 | |
| Multiple types | 9 | 19 | 15 | 27 | 9 | 16 | |
| Unclassified | 2 | 4 | 0 | 0 | 0 | 0 | |
| Medications | | | | | | | |
| None | 2 | 4 | 1 | 2 | 3 | 5 | 0.7051 |
| One | 36 | 75 | 49 | 84 | 46 | 79 | |
| Polytherapy | 10 | 21 | 8 | 14 | 9 | 16 | |

*p* value reported is for ANOVA *F*-test for equality of means for continuous variables, and $\chi^2$ test or Fisher's exact test of association for categorical variables.

[a]Potential range of seizure severity scale is 0 to 36; actual range in our study was 0 to 27.

**Table II**

Child Behavior Checklist (Achenbach 1991) *T*-scores for Total Problems and Internalizing and Externalizing Problems by IQ group and sex; mean (SD) and % at risk[a]

| Scale | Low IQ (56–84) (n=47; 25M, 22F) | Middle IQ (85–100) (n=58; 24M, 34F) | High IQ (101–130) (n=56; 33M, 23F) | p[b] |
|---|---|---|---|---|
| Total | | | | |
| Overall | 64.79 (8.69) | 62.07 (11.43) | 58.05 (10.95) | 0.0055 |
| | 68% | 59% | 43% | 0.0348 |
| Male | 63.56 (7.81) | 61.29 (12.55) | 58.67 (11.88) | |
| | 60% | 54% | 52% | 0.6029 |
| Female | 66.18 (9.58) | 62.62 (10.73) | 57.17 (9.64) | 0.1159 |
| | 77% | 62% | 30% | |
| Internalizing Problems | | | | |
| Overall | 63.30 (9.03) | 61.66 (11.18) | 58.77 (12.80) | 0.1161 |
| | 70% | 52% | 48% | 0.0636 |
| Male | 62.56 (8.74) | 60.75 (12.56) | 59.94 (12.36) | |
| | 64% | 42% | 52% | 0.5083 |
| Female | 64.14 (9.48) | 62.29 (10.24) | 57.09 (13.51) | 0.3483 |
| | 77% | 59% | 43% | |
| Externalizing Problems | | | | |
| Overall | 57.62 (10.08) | 55.66 (11.41) | 53.57 (9.99) | 0.1546 |
| | 43% | 33% | 30% | 0.4015 |
| Male | 57.24 (9.00) | 55.58 (11.75) | 54.03 (11.05) | |
| | 44% | 29% | 36% | 0.8983 |
| Female | 58.05 (11.38) | 55.71 (11.34) | 52.91 (8.42) | 0.4948 |
| | 41% | 35% | 22% | |

[a] For Total Problems and Internalizing and Externalizing Problems, at risk is defined as a score of 60 or higher. In addition, normative mean (SD) for these scales are 50 and 10 respectively, and normative percentage at risk is 16%.

[b] For mean, *p* value is for ANOVA *F*-test for IQ group overall and interaction of sex and IQ group when reporting results by sex. For percentage at risk, *p* value is for Wald test from logistic model for IQ group overall and interaction of sex and IQ group when reporting results by sex. *p* value for comparing percentage at risk is below that for comparing means when both are present.

**Table III**

Child Behavior Checklist (Achenbach 1991) *T*-scores for Internalizing and Externalizing Problems by IQ group and sex; mean (SD) and % at risk[a]

| | Low IQ (56–84) (n=47; 25M, 22F) | Middle IQ (85–100) (n=58; 24M, 34F) | High IQ (101–130) (n=56; 33M, 23F) | p[b] |
|---|---|---|---|---|
| **Internalizing Problems** | | | | |
| Withdrawn | | | | |
| Overall | 61.89 (8.67) | 60.52 (8.55) | 58.96 (8.24) | 0.0707 |
| | 40% | 28% | 20% | |
| Male | 60.84 (8.98) | 59.67 (9.11) | 59.70 (8.38) | 0.6924 |
| | 40% | 29% | 24% | |
| Female | 63.09 (8.35) | 61.12 (8.21) | 57.91 (8.09) | |
| | 41% | 26% | 13% | |
| Somatic Complaints | | | | |
| Overall | 63.60 (9.58) | 64.69 (10.54) | 61.05 (10.69) | 0.5917 |
| | 40% | 43% | 34% | |
| Male | 62.16 (7.87) | 65.46 (10.23) | 60.21 (9.54) | 0.5380 |
| | 36% | 50% | 36% | |
| Female | 65.23 (11.19) | 64.15 (10.87) | 62.26 (12.27) | |
| | 45% | 38% | 30% | |
| Anxious/Depressed | | | | |
| Overall | 60.43 (8.08) | 59.41 (9.58) | 59.05 (9.87) | 0.9915 |
| | 23% | 22% | 23% | |
| Male | 60.16 (8.07) | 58.67 (10.99) | 60.18 (10.53) | 0.8676 |
| | 24% | 25% | 27% | |
| Female | 60.73 (8.27) | 59.94 (8.58) | 57.43 (8.81) | |
| | 23% | 21% | 17% | |
| **Externalizing Problems** | | | | |
| Delinquent Behavior | | | | |
| Overall | 56.81 (7.17) | 56.55 (7.94) | 54.63 (5.92) | 0.0775 |
| | 15% | 21% | 5% | |
| Male | 55.72 (6.14) | 56.79 (9.03) | 54.70 (6.39) | 0.1696 |
| | 8% | 29% | 6% | |
| Female | 58.05 (8.15) | 56.38 (7.21) | 54.52 (5.31) | |
| | 23% | 15% | 4% | |
| Aggressive Behavior | | | | |
| Overall | 59.45 (9.61) | 58.74 (9.50) | 56.41 (7.70) | 0.2435 |
| | 26% | 21% | 13% | |
| Male | 58.88 (8.35) | 58.71 (9.20) | 57.39 (8.48) | 0.4736 |
| | 28% | 21% | 18% | |
| Female | 60.09 (11.04) | 58.76 (9.84) | 55.00 (6.33) | |
| | 23% | 21% | 4% | |

[a] For Syndrome scales, at risk is defined as a score of 67 or higher. In addition, normative means (SDs) for these scales are 54 and 6, respectively, and normative percentage at risk is approximately 1 to 2%.

[b] *p* value is for Wald test from logistic model for IQ group overall or interaction of sex and IQ when reporting results by sex.

**Table IV**

Child Behavior Checklist (Achenbach 1991) *T*-scores for Syndrome scale by IQ group and sex; mean (SD) and % at risk[a]

| Problems | Low IQ (56–84) (n=47; 25M, 22F) | Middle IQ (85–100) (n=58; 24M, 34F) | High IQ (101–130) (n=56; 33M, 23F) | p[b] |
|---|---|---|---|---|
| Social Problems | | | | |
| Overall | 67.77 (10.18) | 65.41 (10.74) | 59.38 (10.11) | 0.0034 |
| | 51% | 43% | 20% | |
| Male | 64.84 (7.81) | 64.71 (11.56) | 59.36 (9.04) | 0.8095 |
| | 44% | 42% | 18% | |
| Female | 71.09 (11.63) | 65.91 (10.27) | 59.39 (11.70) | |
| | 59% | 44% | 22% | |
| Thought Problems | | | | |
| Overall | 61.32 (7.69) | 61.64 (9.37) | 59.09 (7.74) | 0.2739 |
| | 36% | 24% | 23% | |
| Male | 62.04 (6.97) | 62.63 (10.44) | 60.39 (8.40) | 0.1866 |
| | 36% | 38% | 33% | |
| Female | 60.50 (8.52) | 60.94 (8.62) | 57.22 (6.40) | |
| | 36% | 15% | 9% | |
| Attention Problems | | | | |
| Overall | 69.85 (10.10) | 68.26 (12.27) | 61.63 (9.17) | 0.0009 |
| | 64% | 60% | 30% | |
| Male | 67.48 (9.99) | 67.63 (13.24) | 62.39 (10.25) | 0.0013 |
| | 48% | 54% | 39% | |
| Female | 72.55 (9.76) | 68.71 (11.71) | 60.52 (7.45) | |
| | 82% | 65% | 17% | |

[a] For Syndrome scales, at risk is defined as a score of 67 or higher. In addition, normative means (SDs) for these scales are 54 and 6 respectively, for all Syndrome scales except Thought Problems, which has a mean of 53 (SD 6). Normative percentage at risk is approximately 2%.

[b] *p* value is for Wald test from logistic model for IQ group overall or interaction of sex and IQ when reporting results by sex.

**Table V**

Self Concept and Depression by IQ group and sex; mean (SD) and % at risk

| Measure | Low IQ (56–84) | Middle IQ (85–100) | High IQ (101–130) | p[b] |
|---|---|---|---|---|
| **Piers–Harris Self-Concept Scale** | *(n=47; 24M, 23F)* | *(n=56; 23M, 33F)* | *(n=57; 33M, 24F)* | |
| Total | | | | |
| Overall | 54.61 (10.77) | 59.49 (11.81) | 61.78 (12.20) | 0.0079 |
| Male | 60.31 (7.78) | 60.24 (12.83) | 61.62 (12.71) | 0.0183 |
| Female | 48.67 (10.34) | 58.97 (11.23) | 62.00 (11.72) | |
| Anxiety | | | | |
| Overall | 8.23 (3.22) | 9.54 (3.16) | 10.04 (3.33) | 0.0175 |
| Male | 10.25 (2.27) | 10.91 (2.92) | 10.52 (3.01) | 0.0426 |
| Female | 6.13 (2.69) | 8.58 (3.00) | 9.38 (3.69) | |
| Behavior | | | | |
| Overall | 12.71 (2.48) | 13.32 (2.84) | 13.81 (2.42) | 0.1035 |
| Male | 13.17 (2.37) | 12.70 (3.02) | 13.55 (2.69) | 0.1342 |
| Female | 12.24 (2.55) | 13.76 (2.66) | 14.17 (1.99) | |
| Happiness | | | | |
| Overall | 8.72 (1.92) | 9.79 (1.50) | 9.79 (1.63) | 0.0016 |
| Male | 9.38 (1.61) | 9.87 (1.42) | 9.64 (1.73) | 0.0326 |
| Female | 8.04 (2.01) | 9.73 (1.57) | 10.00 (1.50) | |
| Physical Appearance | | | | |
| Overall | 10.13 (3.14) | 10.52 (2.85) | 11.18 (2.83) | 0.1789 |
| Male | 11.33 (2.41) | 10.83 (3.08) | 10.86 (3.24) | 0.0200 |
| Female | 8.88 (3.38) | 10.30 (2.70) | 11.63 (2.14) | |
| Popularity | | | | |
| Overall | 8.66 (3.07) | 10.14 (3.43) | 10.35 (3.75) | 0.0310 |
| Male | 9.83 (2.91) | 10.61 (3.80) | 10.48 (4.01) | 0.2847 |
| Female | 7.43 (2.79) | 9.81 (3.17) | 10.17 (3.43) | |
| School | | | | |
| Overall | 11.65 (2.77) | 12.63 (3.28) | 13.70 (2.88) | 0.0029 |
| Male | 12.71 (2.66) | 12.35 (3.17) | 13.61 (3.07) | 0.0547 |
| Female | 10.55 (2.48) | 12.82 (3.40) | 13.83 (2.65) | |
| **Child Depression Inventory** | *(n=48; 25M, 23F)* | *(n=56; 22M, 34F)* | *(n=57; 33, 24F)* | |
| Total score | | | | |
| Overall | 10.81 (6.61) | 7.97 (6.59) | 6.72 (6.54) | 0.0066 |
| | 31% | 20% | 12% | 0.0631 |
| Male | 9.06 (4.61) | 7.66 (6.47) | 6.85 (7.44) | 0.2852 |
| | 20% | 23% | 15% | 0.1689 |
| Female | 12.70 (7.93) | 8.18 (6.75) | 6.54 (5.20) | |
| | 43% | 18% | 8% | |

[a] For mean, *p* value is for ANOVA *F*-test for equality of means overall and for interaction of IQ group and sex when reporting results by sex. For percentage at risk (Child Depression Inventory only), *p* value is for Wald test from logistic model for IQ group overall and interaction of sex and IQ group when reporting results by sex. *p* value for comparing percentage at risk is below that for comparing means when both are present.

[b] For CDI, at risk is defined as a score greater than 12.