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The role of executive functioning in quality of life in pediatric intractable epilepsy

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ABSTRACT

Objective: Children with epilepsy are vulnerable to executive dysfunction, but the relationship between executive functioning (EF) and quality of life (QOL) in children with epilepsy is not fully delineated. This exploratory study elucidated the relationship between ecological EF and QOL in pediatric intractable epilepsy.

Method: Fifty-four consecutively referred pediatric epilepsy surgery candidates and their parents were administered IQ measures, the Behavior Rating Inventory of Executive Function (BRIEF), and the Quality of Life in Childhood Epilepsy (QOLCE) as part of a comprehensive neuropsychological evaluation.

Results: A significant difference was found in QOL between those with and without clinical impairments on the BRIEF [$t(52) = 3.93$; $p < .001$]. That is, children with executive dysfunction had lower overall QOL. All seizure variables and BRIEF scales were associated with overall QOL [$F(12, 40) = 6.508$; $p = .001$; $R^2 = .661$]. Working memory from the BRIEF was the most frequently elevated scale in our sample (57%). Those with executive dysfunction had 9.7 times the risk of having poor QOL.

Conclusions: Poor EF control according to behavior ratings is significantly related to QOL in intractable pediatric epilepsy. Identification of executive dysfunction in home environments is an essential component of presurgical evaluations and target for intervention, which may improve QOL.

1. Introduction

Epilepsy is one of the most common neurological disorders, affecting approximately 50 million individuals worldwide. At least half of the cases begin in childhood or adolescence [1]. A growing body of evidence indicates that children with epilepsy have poorer quality of life (QOL) than healthy controls or children with other chronic health conditions [2–4]. Quality of life, which encompasses aspects of both physical and mental health [5], is especially lower in children with refractory or intractable epilepsy compared with those with other chronic illnesses [2].

Several factors are known to influence QOL in children with epilepsy. It is well established that psychiatric comorbidities such as depression and anxiety adversely impact QOL [2,3,6,7]. With respect to cognition, Full Scale IQ is predictive of QOL in children with epilepsy [8]. In fact, cognitive problems have been found to be the strongest risk factor for compromised QOL 2 years after diagnosis [9], while a combination of emotional and behavioral difficulty and low verbal memory have been shown to produce a 17-fold increase in risk of lower QOL [10].

The term "executive functions" refers to a broad set of behaviors and distinctive set of activities involving volition, planning and decision-making, purposive action, and effective performance [11]. Children with epilepsy frequently demonstrate poor executive functioning (EF) skills on both performance-based neuropsychological measures [12,13] and from parents' perspectives of children's everyday behaviors [14–16]. Like QOL, EF skills involve several aspects of everyday functioning such as reading and mathematics [17], as well as social adaptive functioning [18].

Disruption to the normal acquisition and trajectory of higher order EF skills may produce deleterious effects on QOL. In adults with ADHD, EF self-ratings contributed to QOL scores [19]. In children with brain tumors, moderate-to-strong correlations have been found between parent QOL ratings and parent report of EF [20], and in children with autism spectrum disorders, lower QOL has been found to be related to EF deficits [21].

Since EF can impact the daily life of children with epilepsy, the relationship between EF and QOL in this population is of particular interest. Epilepsy seizure variables are mutually involved in both constructs,

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which prompt further investigation of the relationship between these variables. Both executive dysfunction and poor QOL are associated with increased seizure frequency [22,23] and earlier age of seizure onset [7,22]. Additionally, children with related EF difficulties such as ADHD have been shown to have poorer QOL than controls [24].

Despite the well documented difficulties in EF and QOL in children with epilepsy, only one study to date has examined the relationship between these domains. Sherman et al. [25] found that ecological EF impairments were significantly related to poor health-related QOL in a pediatric sample with medically refractory epilepsy. Correlations suggestive of a link between increasing executive dysfunction and worse QOL were found between the global executive composite (GEC) of the Behavior Rating Inventory of Executive Function (BRIEF) [26], a parent-report questionnaire of EF, and scores on the impact of childhood illness scale (ICI) [27], a parent-report measure of QOL in children with chronic illnesses. When predictors such as neurological variables (number of AEDs and number of failed AEDs; AEDs = antiepileptic drugs) and adaptive functioning (as defined by the Scales of Independent Behavior—Revised [SIB-R; [28]] Broad Independence score, a measure regarding an individual's ability to function independently in the home and community) were controlled for, variance in QOL was accounted for by BRIEF parent ratings. The MI, BRI, and GEC indices on the BRIEF were moderately correlated with total QOL scores on the ICI. Finally, EF was found to be as important in predicting QOL as seizure variables (including number of AEDs and number of failed AEDs).

The purpose of this exploratory study in a heterogeneous clinically referred sample with intractable pediatric epilepsy was to evaluate further if 1) poor QOL exists in this population using an epilepsy-specific measure, 2) whether problems with everyday EF can explain poor QOL, and 3) whether EF and QOL difficulties are related to epilepsy characteristics. It was hypothesized that reduced QOL in children with intractable epilepsy would be related to EF impairment and not to specific epilepsy features such as lateralization or localization of seizure foci.

2. Material and methods

2.1. Participants

Fifty-four children and adolescents with epilepsy (28 males; majority right-handed, $n = 44$; 82%; and Caucasian, $n = 38$; 70%) between the ages of 6 and 18 were included in this study. The mean age of the total sample was 11.59 ($SD = 3.34$). Participants represented consecutive referrals for baseline neuropsychological evaluations for the purposes of presurgical planning. As a part of their evaluation, parents and/or legal guardians of the participants completed questionnaires, including the BRIEF and Quality of Life in Childhood Epilepsy (QOLCE). Confirmation of intractable epilepsy diagnosis was conducted via continuous video-EEG monitoring by an epileptologist. EEG was used to establish seizure type (e.g., focal, generalized, or mixed) as well as lateralization and localization of seizure foci. Epilepsy severity variables were documented, including age of seizure onset, time since seizure onset (i.e., duration of epilepsy disorder), number of AEDs, number of failed AEDs, and seizure frequency. Regarding intellectual functioning, we did not exclude children with intellectual disability ($IQ < 70$) if the behavioral presentation of the child indicated adequate cooperation and ability to maintain attention without excessive off-task behaviors that would invalidate the assessment procedures. As many children with intractable epilepsy have comorbid intellectual disability, excluding them would have limited our ability to understand the relation of EF to QOL in this vulnerable segment of the population. Comorbid psychiatric diagnoses of depression, anxiety, or both were made in 11 of the 54 children (20%) using the *Diagnostic and Statistical Manual of Mental Disorders — Text Revision* (DSM-IV-TR) criteria [29] as part of their clinical evaluation including parent and child interview, as well as standardized self-report and parent-report questionnaires. Table 1 demonstrates the demographic and clinical characteristics of the sample. The study was approved by the Florida Hospital and the Florida Institute of Technology Institutional Review Boards.

Table 1
Demographic and clinical characteristics of the sample (N = 54).

	Mean	*SD*	Range
Age[a]	11.59	3.34	6–18
Age at seizure onset[a]	6.32	3.87	0–13
Duration of epilepsy[a]	5.68	3.82	0.08–17.83
Number of AEDs[b]	1.59	0.71	0–3
Number of failed AEDs[b]	2.30	2.18	0–10
Race	38 (70.4%) Caucasian 8 (14.8%) African-American 5 (9.3%) Hispanic/Latino 3 (5.6%) mixed/other		
Handedness	44 (81.5%) right 9 (16.7%) left 1 (1.9%) mixed/ambidextrous		
Seizure type	42 (77.7%) focal 12 (22.2%) generalized/mixed		
Number of AEDs[b]	2 (3.7%) no medications 23 (42.6%) 1 medication 24 (44.4%) 2 medications 5 (9.3%) 3 medications		
Number of previously failed AEDs[b]	7 (13%) no medications 16 (29.6%) 1 medication 13 (24.1%) 2 medications 6 (11.1%) 3 medications 12 (53.22%) >3 medications		
Seizure frequency	17 (31.5%) at least 1 daily 19 (35.2%) at least 1 weekly 18 (33.3%) less than 1 weekly		
Seizure lateralization	21 (38.9%) left 17 (31.5%) right 16 (29.6%) bilateral		
Seizure localization	20 (37.0%) multilobar 11 (20.4%) temporal 9 (16.7%) frontotemporal 9 (16.7%) frontal 3 (5.6%) parietal 2 (3.7%) occipital		

[a] Years.
[b] AEDs = antiepileptic medications.

2.2. Neuropsychological measures

BRIEF

The Behavior Rating Inventory of Executive Function (BRIEF) was chosen as a parent-report measure of EF as it was designed to assess multiple interrelated domains of children's EF in an everyday, real-world setting. The BRIEF utilizes parent input to capture a broad range of executive skills [26]. Several indices are derived from eight clinical scales including the metacognition index (MI), the behavioral regulation index (BRI), and an overall global executive composite (GEC) score. Regarding psychometric properties, the BRIEF has been found to have high internal consistency of .80 to .98 (alpha coefficients). Test–retest reliability correlation was reported as $r = .81$ for parents and $r = .88$ for teachers, over an average interval of two weeks. Convergent validity was established with other measures of inattention, impulsivity, and learning skills, while divergent validity was demonstrated against measures of emotional and behavioral functioning [26]. Age- and gender-corrected T-scores were utilized in analyses.

QOLCE

The Quality of Life in Childhood Epilepsy Questionnaire (QOLCE) is a parent-rated measure designed and validated to assess the QOL of children with epilepsy [30]. The National Institute of Neurological Disorders and Stroke [31] Common Data Elements recommends using the QOLCE for the assessment of QOL in pediatric epilepsy. The QOLCE consists of 77 items that assess the frequency with which children experience