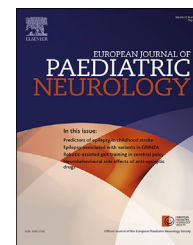




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Original article

The impact of intelligence on memory and executive functions of children with temporal lobe epilepsy: Methodological concerns with clinical relevance



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ABSTRACT

Purpose: Patients with TLE are prone to have lower IQ scores than healthy controls. Nevertheless, the impact of IQ differences is not usually considered in studies that compared the cognitive functioning of children with and without epilepsy. This study aimed to determine the effect of using IQ as a covariate on memory and attentional/executive functions of children with TLE.

Methods: Thirty-eight children and adolescents with TLE and 28 healthy controls paired as to age, gender, and sociodemographic factors were evaluated with a comprehensive neuropsychological battery for memory and executive functions. The authors conducted three analyses to verify the impact of IQ scores on the other cognitive domains. First, we compared performance on cognitive tests without controlling for IQ differences between groups. Second, we performed the same analyses, but we included IQ as a confounding factor. Finally, we evaluated the predictive value of IQ on cognitive functioning.

Results: Although patients had IQ score in the normal range, they showed lower IQ scores than controls ($p = 0.001$). When we did not consider IQ in the analyses, patients had worse performance in verbal and visual memory (short and long-term), semantic memory, sustained, divided and selective attention, mental flexibility and mental tracking for semantic information. By using IQ as a covariate, patients showed worse performance only in verbal memory (long-term), semantic memory, sustained and divided attention and in mental flexibility. IQ was a predictor factor of verbal and visual memory (immediate and delayed), working memory, mental flexibility and mental tracking for semantic information.

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Conclusion: Intelligence level had a significant impact on memory and executive functioning of children and adolescents with TLE without intellectual disability. This finding opens the discussion of whether IQ scores should be considered when interpreting the results of differences in cognitive performance of patients with epilepsy compared to healthy volunteers.

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1. Introduction

Several studies have investigated cognitive functioning in children with epilepsy.^{1–3} In a community-based prospective study, Berg et al.,¹ evaluating 613 children with epilepsy, reported that 24.4% had intellectual quotients (IQ) lower than 80 and 21.3% had an IQ lower than 70, at the time of initial diagnosis of epilepsy. This fact illustrates the significant number of patients with some degree of intellectual deficit. In tertiary centers for epilepsy treatment, these figures come to alarming number of 49.1% of patients with intellectual disability and 54.7% with low intelligence scores.³

Temporal lobe epilepsy (TLE), particularly caused by mesial temporal sclerosis, is the most common form of pharmacoresistant epilepsy in adults referred to tertiary epilepsy centers.⁴ Episodic memory impairment represents the single most frequent cognitive deficit in adults and⁵ children with TLE.⁶ Children and adults with TLE may also have impairments in semantic memory,^{7,8} attentional and executive functions (review in⁸). In a large sample of children with unilateral TLE, Cormack et al.⁹ showed that 57% of their sample had an IQ lower than 79 and that among those with IQs in the normal range, 19% had low average intelligence.

The relationship between intellectual processes and other cognitive functions has been vastly determined by studies with theoretical models of intelligence. In the general factor model of intelligence of Spearman (g factor), there is an emphasis on the role of executive control in intelligence.^{10,11} Likewise, the Cattell-Horn-Carroll framework¹² stresses the relevance of several broad classes of abilities at the higher level (i.e. fluid ability, crystallized intelligence, short-term memory, long-term storage and retrieval, processing speed) and a number of primary factors at the lower level (quantitative reasoning, spelling ability, free recall, simple reaction time) for intelligence. Thus, intelligence reflects the average or combined activity of many separate cognitive functions.¹³

In this scenario, intelligence may influence other cognitive functions and be, at least partially, contributing to the cognitive impairment profile already described in children with TLE. Despite this robust and well-known association between intelligence and cognition, several case-control studies that addressed the cognitive profile of children with TLE did not consider the IQ as a possible confounding variable.^{7,14–17} We

aimed to determine the impact of intelligence on memory and attentional/executive functions of children and adolescents with TLE. Therefore, we tested the mediation effect of IQ scores in executive and memory functions in a sample of children with unilateral TLE, without intellectual disability, compared with healthy controls.

2. Methods

2.1. Participants

Patients with unilateral TLE were recruited from children and adolescents under treatment at Clinic's Hospital – University of São Paulo, tertiary epilepsy care center. Healthy volunteers, matched for age, sociodemographic profile, and educational background composed the control group. Healthy controls were recruited among students that attended a public school in the same neighborhood of the hospital where patients were followed.

Exclusion criteria, applied for patients and controls, were: an estimated IQ below 70; less than 7 years-old or more than 16 years-old; clinical signs of drug intoxication or of any other condition that could lead to cognitive impairment; alcohol or drug abuse; any neurosurgical procedure; and not currently attending school. Children with lifetime history of major psychiatric disorders (DSM-IV-TR),¹⁸ history of other neurological disorders, moderate to severe learning disabilities, with attention deficit hyperactivity disorder and using psychoactive drugs that might impair neuropsychological performance were also excluded.

This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) and parents or legal guardians of patients and controls have signed a written informed consent.

2.1.1. Patients

We prospectively evaluated 38 children and adolescents with TLE [50% males; mean age 11.92 ± 2.28 years (range 8–16 years)]. Mean IQ, estimated on the basis of performance on the Block Design and Vocabulary subtests of the Wechsler Intelligence Scale for Children-Third Edition,¹⁹ was 97.35 ± 13.36 (range, 71–135).

The mean age at epilepsy onset was 4.49 ± 3.30 years and mean duration of epilepsy was 6.98 ± 3.25 years. Twenty-one

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