Studies reveal the surprising complexity of cognitive issues in children with epilepsy

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Generalized 3 Hz spike and wave discharges in a child with childhood absence epilepsy. Credit: Wikipedia.

Children with epilepsy face a number of challenges compared with their healthy peers, including an increased risk of cognitive impairment. Three studies presented the American Epilepsy Society's (AES) 69th Annual Meeting parse the complex underpinnings of cognitive development in these children, revealing a need for smarter assessments and targeted interventions.

Traditional neuropsychological assessments have an inherently limited ability to describe how children with epilepsy progress toward developmental milestones, and how relationships between cognitive skills evolve over time.

To explore how cognitive milestones develop in children with epilepsy compared with their healthy peers, researchers from the University of Wisconsin-Madison and the University of California-Irvine (abstract 2.338) turned to techniques from a branch of mathematics known as graph theory.

The authors administered a comprehensive battery of neuropsychological tests to 178 children ranging in age from 8 to 18 years, including 104 children with new or recent-onset epilepsy and 74 of their normally developing cousins. Tests were administered at baseline and after 2 years to reveal changes in intelligence, academic achievement, language, memory, executive function, and cognitive/psychomotor speed over time. Results were analyzed via graph theory and traditional analytic approaches.

According to traditional analyses, healthy children outscored children with epilepsy at baseline and, because the groups continued to develop in a parallel fashion, these differences remained 2 years later. Graph analyses, however, revealed a deeper level of complexity, suggesting that cognitive development in both groups is organized around two hubs: verbal intelligence and category switching, or the ability to switch

between multiple trains of thought, which is an executive function. The graph analysis further suggested that the neural networks linking various cognitive skills are not well integrated in children with epilepsy compared with their healthy peers.

"Children with epilepsy show global differences in the development of their cognitive networks, but the hubs of these networks are functionally similar to those of their healthy peers," says Camille Garcia-Ramos, a graduate student in the Department of Medical Physics at the University of Wisconsin. "Our analysis captures a dynamic and changing complexity in the relationships among diverse cognitive skills, and show how cognitive networks mature differently in normally developing children and children with epilepsy."

A second study (abstract 1.143) reveals changes in white matter that may help explain the cognitive impairment experienced by children with early-onset epilepsy.

Noting that the overall risk of cognitive impairment is not consistent with clinical factors such as seizure frequency, researchers from the University of Edinburgh and Scotland's National Health Service explored the idea that pre-existing abnormalities in white matter integrity are present in children with cognitive impairment and early-onset epilepsy, but not in children with normal cognition. The authors performed cognitive testing and MRI in 17 children who had an average age of 32 months and experienced a first seizure at 25 months.

The study uncovered evidence of abnormalities in one particular white matter tract known as the right inferior longitudinal fasiculus (ILF), which has also been implicated in autism spectrum disorder. The ILF is thought to play an important role in object/face recognition and has also been associated with general cognitive ability and processing speed.

"To our knowledge this study provides the first evidence that reduced cognitive ability in children with early-onset epilepsy may be associated with specific white matter abnormalities," says author Michael Yoong, Ph.D., a clinical lecturer at the Muir Maxwell Epilepsy Centre of the University of Edinburgh.

A third study (abstract 1.293) demonstrates how a brief computerized screening strategy can be used to detect cognitive changes in children with epilepsy. Though cognitive screening is routinely performed in children with epilepsy, few studies have explored the reliability of these protocols.

Researchers from the University of Pittsburgh School of Medicine examined how accurately the CNS Vital Signs computerized cognitive battery, combined with parent screening tools, could identify children with cognitive and behavioral challenges. The authors studied 33 children, ranging from 8 to 17 years old, who were diagnosed with recent-onset epilepsy who had not yet started taking medication for the condition. The screening tests were repeated at 5.5 months and, in some cases, at 14.5 months.

Their findings revealed clinically significant changes in one or more cognitive domains - most often composite memory, cognitive flexibility, reaction time and complex attention - between the first and second screens. Psychomotor speed did not change, however, and no distinctive patterns of change were noted in response to seizure type, medication, parent reports, or other clinical factors.

"Our study shows that brief computerized cognitive screening at the time of epilepsy diagnosis and shortly after initiation of treatment can help identify patients at elevated risk for cognitive difficulties. But parental reports alone may not prompt referral for further evaluation," says Megan Bone, a medical student at the University of Pittsburgh.

"Cognitive screening may enhance the detection of cognitive changes early in epilepsy and allow for swift intervention, potentially improving academic performance and quality of life."

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