Brain MRIs may provide an early diagnostic marker for dyslexia

January 23 2012

Children at risk for dyslexia show differences in brain activity on MRI scans even before they begin learning to read, finds a study at Children's Hospital Boston. Since developmental dyslexia responds to early intervention, diagnosing children at risk before or during kindergarten could head off difficulties and frustration in school, the researchers say. Findings appear this week in the online Early Edition of the *Proceedings of the National Academy of Sciences*.

Developmental dyslexia (dyslexia that's not caused by brain trauma) affects 5 to 17 percent of all children; up to 1 in 2 children with a family history of dyslexia will struggle with reading themselves, experiencing poor spelling and decoding abilities and difficulties with fluent word recognition. Because of problems recognizing and manipulating the underlying sound structures of words (known as phonological processing), children with dyslexia have difficulty mapping oral sounds to written language.

The Children's Hospital Boston researchers, led by Nora Raschle, PhD, of the Laboratories of Cognitive Neuroscience, performed functional MRI imaging in 36 preschool-age children (average age, 5 1/2) while they performed tasks requiring them to decide whether two words started with the same speech sound. They used an elaborate protocol to get these young children to hold still in the MRI scanner.

During the phonological tasks, children with a family history of dyslexia had reduced metabolic activity in certain brain regions (the junctions between the occipital and temporal lobes and the temporal and parietal lobes in the back of the brain) when compared with controls matched for age, IQ and socioeconomic status.

"We already know that older children and adults with dyslexia have dysfunction in the same brain regions," says senior investigator Nadine Gaab, PhD, also of the Laboratories of Cognitive Neuroscience. "What this study tells us is that the brain's ability to process language sounds is deficient even before children have reading instruction."

In both the at-risk and control groups, children with high activation in these brain areas had better pre-reading skills, such as rhyming, knowing letters and letter sounds, knowing when two words start with the same sound, and being able to separate sounds within a word (like saying "cowboy" without the "cow").

The children at risk for dyslexia showed no increase in activation of frontal brain regions, as has been seen in older children and adults with dyslexia. This suggests that these regions become active only when children begin reading instruction, as the brain tries to compensate for other deficits.

Studies have shown that children with dyslexia often have negative experiences in school, being labeled as lazy or unmotivated. Their frustration can lead to aggressive, impulsive and anti-social behaviors and an increased likelihood of dropping out of high school and entering the juvenile justice system.

"We hope that identifying children at risk for dyslexia around preschool or even earlier may help reduce the negative social and psychological consequences these kids often face," says Raschle.

While various neuropsychological interventions are available for dyslexia, the condition generally isn't diagnosed until the child has reached third grade, when they are less effective, Gaab adds.

"Families often know that their child has dyslexia as early as kindergarten, but they can't get interventions at their schools," she says. "If we can show that we can identify these kids early, schools may be encouraged to develop programs."

Gaab and Raschle plan to follow the children over time to see if the brain patterns they observed correlate with a later diagnosis of dyslexia They just received a large NIH grant to extend their study, and are actively enrolling preschool-aged children (for information on enrollment, contact the Gaab lab.

Provided by Children's Hospital Boston