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CHILDHOOD SLEEP APNEA LINKED TO BRAIN DAMAGE, LOWER IQ
—“A Wake-Up Call” for Parents and Pediatricians—

In what is believed to be the first study showing neural changes in the brains of children with serious, untreated sleep apnea, Johns Hopkins researchers conclude that children with the disorder appear to suffer damage in two brain structures tied to learning ability.

Writing in the Aug. 22 issue of the global online journal *Public Library of Science Medicine*, the Hopkins investigators say they compared 19 children with severe obstructive sleep apnea (OSA) to 12 children without the disorder. Using a special type of MRI, researchers identified changes to the hippocampus and the right frontal cortex. Next, using IQ tests and other standardized performance tests that measure verbal performance, memory and executive function, researchers were able to link the changes in the two brain structures to deficits in neuropsychological performance.

The hippocampus, a structure in the temporal lobe, is vital to learning and memory storage, while the right frontal cortex governs higher-level thinking, such as accessing old memories and using them in new situations.

“This should be a wake-up call to both parents and doctors that undiagnosed or untreated sleep apnea might hurt children’s brains,” says lead author Ann Halbower, M.D., a lung specialist at the Johns Hopkins Children’s Center. “This is truly concerning because we saw changes that suggest brain injury in areas of the brain that house critical cognitive functions, such as attention, learning and working memory.”

While researchers have known for years that fragmented sleep, interrupted breathing and oxygen deprivation - all hallmarks of sleep apnea - harm children’s learning ability and school performance, this is the first time they have linked changes in the brain’s chemistry to the syndrome in children, Halbower believes.

“We cannot say with absolute certainty that sleep apnea caused the injury, but what we found is a very strong association between changes in the neurons of the hippocampus and the right frontal cortex and IQ and other cognitive

functions in which children with OSA score poorly," Halbower says.

Children with OSA had lower mean IQ test scores (85) than children without OSA (101). Children with OSA also performed worse on standardized tests measuring executive functions, such as verbal working memory (8 versus 15) and word fluency (9.7 versus 12).

Using magnetic resonance spectroscopic imaging, which plots peak levels of brain chemicals in the form of graphs, researchers compared the ratios between each two of three chemicals - N-acetyl aspartate (NAA), creatine and choline - in children with apnea and in those without. The hippocampus and the right frontal cortex of children with sleep apnea showed altered ratios of these neurochemicals that are not specific to any one disease but indicate injury to brain cells. Next, researchers plan to study whether the ratios will return to normal once the sleep apnea is treated.

In both children and adults, untreated sleep apnea has been linked to cardiovascular problems and learning and memory deficits. However, the cognitive effects of untreated apnea might be far more damaging in children than in adults, researchers point out, because they occur during critical developmental periods. The frontal cortex matures throughout the teen years and continues well into the 30s, and researchers fear that childhood injury to this area might lead to long-term cognitive deficits.

Obstructive sleep apnea affects 2 percent of children in the United States, but it is unclear how many of these suffer from severe apnea. Halbower estimates that up to 17 percent of sleep apnea patients seen at the Children Center's sleep clinic have the severe form.

Sleep apnea occurs because of partial or complete obstruction of the airways during sleep due to anatomic and/or neuromotor factors. In children, the leading cause of sleep apnea is enlarged tonsils and adenoids, and the first line of treatment is surgical removal. Another treatment is wearing a special mask at night to ensure smooth airflow and uninterrupted breathing during sleep.

Researchers from the Kennedy Krieger Institute in Baltimore and the University of Pennsylvania participated in the study. Co-authors from Johns Hopkins include Mahaveer Degaonkar, M.D., Peter Barker, M.D., Christopher Earley, M.D., Philip Smith, M.D., and Mark Mahone, M.D. Researchers from other institutions include Cristine Prahme, M.D., of the Kennedy Krieger Institute, and Carole Marcus, M.D., of the University of Pennsylvania School of Medicine.

The research was funded in part by the Thomas Wilson Sanitarium for the Children of Baltimore City and the General Clinical Research Center at The Johns Hopkins University School of Medicine.

Founded in 1912 as the children's hospital of the Johns Hopkins Medical Institutions, the Johns Hopkins Children's Center offers one of the most comprehensive pediatric medical programs in the country, from performing emergency trauma surgery, to finding causes and treatments for childhood cancers, to delivering a child's good bill of health. The Johns Hopkins Children Center's Pediatric Trauma Service is Maryland's only state-designated trauma center for children. With recognized Centers of Excellence in 20 pediatric subspecialties including cardiology, transplant, psychiatric illnesses and genetic disorders, Children's Center physicians, nurses and staff provide compassionate care to more than 90,000 children each year. For more information, please visit www.hopkinschildrens.org

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