Brain Size Tied to Attention Deficit Hyperactivity Diso...

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The brains of children and adolescents in whom attention deficit hyperactivity disorder is diagnosed are on average 3 percent to 4 percent smaller in volume than those of children without the condition, according to a large-scale government study whose findings were reported today.

And the greater the severity of a child's symptoms, the greater the discrepancy in the size of various brain areas, as measured on brain scans, the researchers said.

Disparities in brain volume have been found before in children with the disorder, differences that some had speculated might be a result of the medications commonly used to treat such children.

But the new work, reported today in The Journal of the American Medical Association, found the difference was present even among children who had never taken medication.

"I've always been extremely cautious about overinterpreting results," said Dr. F. Xavier Castellanos, the lead author, who directed the study at the National Institute of Mental Health. "But I think this is a definitive finding and something that needs to be considered."

Still, Dr. Castellanos, now at New York University's Child Study Center, said the difference in overall brain size was "not huge."

While smaller, the brains of the children with attention deficit hyperactivity disorder, also referred to as A.D.H.D., followed the same progression of development as those of the normal children. And the size difference, Dr. Castellanos said, could not be used to diagnose the disorder, because the difference was calculated using group averages and did not necessarily apply in individual cases.

"There are some kids with A.D.H.D. that have the second largest brains in the whole distribution," Dr. Castellanos said. It is not clear whether the size difference between the groups was present at birth but it did appear before school age, he said.

Attention deficit hyperactivity disorder is characterized by distractibility, hyperactivity and/or impulsivity, the American Psychiatric Association diagnostic manual says.

Experts said the study, conducted between 1991 and 2001, was the largest of its kind and the first to follow children over time and to include a large sample of children who had not been medicated.

The researchers used magnetic resonance imaging to examine the brains of 152 children, aged 5 to 18, who had A.D.H.D. and 139 normal children in the same age range. Forty-nine of the children with the disorder were scanned before they had received any medication to treat it.

Critics have argued that Ritalin, Adderall and other drugs used to treat attention disorders were the cause of the size differences in brain areas reported in previous studies.

According to some estimates, 1.3 million children from 5 to 14 in the United States, most of them diagnosed with attention deficit hyperactivity disorder, take Ritalin.

But Dr. Castellanos and his colleagues found that, as in children who had taken medication, the total brain volume of children who had never been medicated was significantly smaller than that of children in the control group.

"This study is so timely," said Dr. B. J. Casey, director of the Sackler Institute for Developmental Biology at Weill Medical College of Cornell University and an expert on pediatric brain imaging. "We've all wanted to see a study like this." The study found that the unmedicated children's brains also showed a "strikingly smaller" volume of white matter, pale central nervous system tissue heavy with fibers.

White matter increases with age, and the unmedicated children tended to be younger than the other participants. But Dr. Castellanos said the finding also raised the possibility that medication might enhance the normal maturation of the brain in children with attention disorders.

The largest size difference the researchers found was in the cerebellum, a brain structure just above the brainstem, which is involved in muscle tone, balance, the synchronization of muscle activity and perhaps other functions. The caudate nucleus, an area deep in the brain that is believed to serve as a relay station for information important in regulating attention and activity level, was also significantly smaller in younger children with A.D.H.D.. But by the time the children were 15, the caudate did not differ in size between the two groups.

Dr. Bradley Peterson, a professor of child psychiatry at Columbia University who is also a brain imaging expert, called the study's methodology "elegant" and said its findings would become a landmark.

But he added, "Unfortunately, it doesn't give us a clear idea as to where, specifically in the brain, things are going wrong for kids with A.D.H.D.," he said.

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