

Childhood obesity linked to structural differences in key brain regions

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Obesity in children is associated with differences in brain structure in regions linked to cognitive control compared to the brains of children who are normal weight, according to new research from the University

of Cambridge.

However, the scientists who led the study stress that it is not possible to say whether obesity causes these [brain changes](#) or whether the [children](#) are obese because their brain structures are different.

Around 124 million children worldwide are thought to be obese. In the UK, almost one in five children are overweight or obese when they start primary school and this figure increases to one in three by the time they begin secondary school. Children who are overweight or obese are more likely to become [obese adults](#), and have an increased risk of poorer health outcomes in later life including diabetes, heart disease and cancer.

Previous studies have linked being overweight with scoring lower on various measures of executive function, an umbrella term for several functions such as self-control, decision making, working memory (temporarily holding information for processing) and response to rewards. Broadly speaking, executive function refers to a set of processes that enable planning, problem solving, flexible reasoning and regulation of behaviours and emotions.

To examine if this link existed in children, researchers at the University of Cambridge and Yale University analysed data from 2,700 children between the ages of 9-11 years who had been recruited as part of the National Institutes of Health Adolescent Brain Cognitive Development (NIH ABCD) Study. The results of their study are published today in the journal *Cerebral Cortex*.

In particular, the researchers looked at the thickness of the cortex, the outer layer of the brain—our so-called 'grey matter' - and compared it to each child's body mass index (BMI). They also analysed results from tests of executive function.

The team found an association between increased BMI and significant reductions in the average (mean) thickness of the cortex, as well as thinning in the pre-frontal region of the cortex, an area associated with cognitive control. This relationship remained after accounting for factors including age, sex, race, parental education, household income and birth-weight.

The researchers also found that increased BMI was associated with poorer performance at tests to measure executive function.

"We saw very clear differences in [brain structure](#) between children who were obese and children who were a healthy weight," says the study's first author Dr. Lisa Ronan from the Department of Psychiatry at the University of Cambridge.

"It's important to stress that the data does not show changes over time, so we cannot say whether being obese has changed the structure of these children's brain or whether innate differences in their brains lead them to become obese."

The NIH ABCD Study will follow these children as they grow older and Dr. Ronan hopes this will enable them to see whether structural differences in the brain change over time and exactly how they relate to obesity. In particular, it may help them understand whether managing a child's weight will make a difference to their executive function.

When the team used [waist circumference](#) and waist-to-height ratio as a measure of obesity, they found that these, too, were associated with reduced executive function, but the link between cortical thickness was more complicated, with some regions showed reduced thickness while others showed increased thickness.

"This unique and openly available dataset has allowed us to examine the

relationships between brain structure, cognitive functions and body weight," adds Professor Paul Fletcher, also at Cambridge's Department of Psychiatry. "The links that we observed suggest that there are very real structural [brain](#) and cognitive differences in children who are obese. The findings contribute a small part towards our growing understanding of the causes and consequences of obesity in children."

More information: Ronan, L., Alexander-Bloch, A. & Fletcher, P. Childhood obesity, cortical structure and executive function in healthy children, *Cerebral Cortex* (2019). [DOI: 10.1093/cercor/bhz257](https://doi.org/10.1093/cercor/bhz257)

Provided by University of Cambridge

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