Early-life obesity linked to children’s lower perceptual reasoning and working memory scores

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A new study by Brown University epidemiologists found that children on the threshold of obesity or overweight in the first two years of life had lower perceptual reasoning and working memory scores than lean children when tested at ages five and eight. The study also indicated that IQ scores may be lower for higher-weight children.

Obesity, which can dysregulate hormones that act in multiple brain regions, is associated with lower cognition in adults, the researchers said. But until now, despite the increasing prevalence of childhood obesity, there has been scant research on whether weight status impacts how children learn, remember information and manage attention and impulses.

“The first few years of life are critical for cognition development, and we investigated whether early-life adiposity has an impact on cognitive abilities later in life,” said Nan Li, lead author and a postdoctoral research associate in Brown’s Department of Epidemiology, who worked with faculty member Joseph Braun on the study.

For the study, featured in the June issue of *Obesity*, Li, Braun and their coauthors focused on a group of children whose weight, relative to their height or length, was known at age one and/or age two, and who later underwent a series of cognitive tests.

These children were part of the Health Outcomes and Measures

of the Environment study in Cincinnati, which first enrolled pregnant women from 2003 to 2006 and followed their children in their early lives. In addition to being measured for weight and height in the first two years of life, each child was followed over time via home visits by trained staff. Each child participated in at least one measurement of their cognitive abilities at age five or age eight.

Weight status

By measuring weight status with a weight-for-height score, which is recommended by the World Health Organization, Li and Braun's study avoided problems associated with previous studies that tracked rapid growth or weight gain, they said. Some children who gain weight may grow rapidly but be lean, while other children may have consistent overweight/obese status but not be classified as having rapid growth. Assessing weight status by looking at weight relative to height, on the other hand, measures adipose tissue. The researchers wanted to study the impact of early-life adiposity on neurodevelopment in children.

The design of the study also allowed them to capture weight status during a period of time when the brain is developing neurological pathways that influence performance and functioning.

This means that the researchers could determine whether a high weight-to-height ratio led to cognitive difficulties, rather than the other way around. In some prior studies, it is difficult to know if excess weight is a result of lower cognition, the authors said. Preexisting low cognitive function could be the root, not the result, of obesity in children, because those children may not have been able to limit their caloric intake or get much physical activity.

Because there were a limited number of children in the study who were overweight or obese, Li said, the researchers grouped

the participants into two categories, lean and non-lean. The non-lean group included some overweight and obese children and others who were approaching the threshold for being overweight or obese.

“We were particularly interested in those children who were at great risk of being overweight or obese,” Li said. The researchers wanted to explore whether those at-risk children had lower cognitive test scores compared to lean children, she said.

Cognitive tests

The children in the study took a series of tests that assessed their general cognitive abilities, memory, attention and impulsivity, according to the study.

One set of tests measured children’s overall intellectual abilities, including verbal abilities and organization skills. A set of computerized tasks assessed children’s attention, impulsivity and executive control, and a maze game tested the children’s visual-spatial memory. A sequencing test assessed working memory, and another set of tests assessed perceptual reasoning.

The researchers found that weight status did not appear to affect performance on some of the tests, but had three significant impacts.

“Excess early-life adiposity was associated with lower IQ, perceptual reasoning and working memory scores at school-age,” Li said.

IQ refers to overall cognitive abilities, while working memory falls under the domain of executive function, which the authors described in the paper as the set of self-regulatory cognitive processes that aid in managing thoughts, emotions and goal-directed behaviors.

“Executive function is associated with academic success in children and is critical for physical health and success throughout life,” the authors wrote.

Perceptual reasoning tests, according to Li, “assess children’s ability to examine a problem, draw upon visual-motor and visual-spatial skills, organize their thoughts, create solutions and then test those solutions.”

The authors wrote that there are a number of biological mechanisms by which early life adiposity could affect neurodevelopment, including pro-inflammatory cytokines that activate inflammatory pathways in children and adults. Systematic inflammation may affect multiple brain regions relevant to cognitive abilities and was shown to adversely affect spatial learning and memory in rodents, according to the study. And the dysregulation of hormones that act on brain regions including the hypothalamus, prefrontal cortex and hippocampus may adversely affect cognition.

The authors pointed out that the sample size of their study was limited and that further studies should be conducted to confirm their findings. Future work could also investigate the impact of early-life weight status on school performance, attention-deficit/hyperactivity disorder diagnoses and special education use.

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