

ADHD and obesity are linked through genetics and pregnancy weight, study finds

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Certain genetic variants are linked to an increased risk of developing both obesity and ADHD, according to a new study.

The researchers found that there are both genetic and prenatal components explaining the association between attention deficit hyperactivity disorder (ADHD) and obesity. Previous studies have suggested that genetics are involved, and the new study found that ADHD is associated with a greater risk of developing obesity and vice versa.

Importantly, the researchers found this can be explained by both the environment in the womb and genetics.

The study is the first to show that children whose mothers had an elevated pre-pregnancy body mass index (BMI) were at a greater risk of developing ADHD, independent of their genetic risk. The results of the team's detailed genetic analysis also suggest that there are genetic variations that predispose people to both ADHD and obesity simultaneously.

Observational studies have previously suggested there is a link between the two conditions but this research used a technique called mendelian randomisation (MR) to explore the genetic causes of this link in detail, and explore whether one condition can lead to the other.

The work was a collaboration between researchers at Imperial College London and Oulu University in Finland, along with other institutions in the UK and Australia.

The team say their results could help clinicians to identify children at risk of developing obesity and ADHD, so that they can intervene early with prevention and treatment. They suggest it would be helpful for clinicians to consider children's increased risk of developing obesity when treating young people with ADHD symptoms and to screen children and adolescents with obesity for signs of ADHD.

The work is published in *Translational Psychiatry*.

Importance of healthy weight in pregnancy

Professor Alina Rodriguez, the senior study author from Imperial College London's School of Public Health, who led the work, says that "there has been a lot of debate about why it seems that people at increased risk of obesity are also at increased risk of ADHD and vice versa. Our study shows that people with certain genetic variants are at increased risk of both, and also that the mother's weight is important—a child whose mother was overweight during pregnancy is at increased risk of developing ADHD even if they do not have these genetic risk factors."

The research could help in the management of both ADHD and obesity, she added.

"Women with a high weight during pregnancy are at increased risk for a number of problems, for themselves and for their children—and this is another one. What's really key here is that we can actually do something to reduce the risk of ADHD, prenatally. The genetics we can't modify, but we can support women with reducing their pre-pregnancy weight if they have a high BMI and they are trying to conceive. Women who are considering getting pregnant can increase their physical activity, look at their nutrition and aim for a healthy weight," said Professor Rodriguez, who is also Honorary Professor at the Centre for Psychiatry and Mental Health, Wolfson Institute of Population Health, at Queen Mary, University of London.

Understanding how ADHD and obesity are linked

The researchers say that there are likely to be numerous different mechanisms and biological pathways driving the causal relationships

found in the study. Obesity is known to trigger systemic chronic inflammation and some researchers are looking at whether this could have an impact on brain function, including ADHD-type symptoms. Others are exploring how the genetic variants in question might affect fetal brain development.

Genetic and environmental factors are also likely to have an additive effect. For example, adolescents with obesity who carry genetic risk for ADHD are more likely to enter any future pregnancy overweight. This compounds the risk of ADHD symptoms in their children and contributes to a vicious cycle. Promoting a healthy maternal weight and good nutrition prior to pregnancy immediately benefits both women and children, say the researchers.

The researchers used mendelian randomisation (MR), which looks at genetic 'surrogates' associated with conditions—in this case ADHD and obesity—to analyze if and how these conditions are linked to one another. Using data from over 700,000 people, they looked at genetic variants associated with six traits related to obesity: BMI, waist circumference, waist-hip-ratio (WHR), BMI-adjusted WHR, body fat percentage, and basal metabolic rate, and at genetic variants associated with inattention and hyperactivity as 'surrogates' for ADHD.

The results showed that genetic surrogates of obesity traits were causally linked to ADHD symptoms and that genetic surrogates of ADHD clearly linked to obesity traits. This confirmed that a genetic predisposition to ADHD was linked to an increased risk of obesity, and vice versa. Professor Rodriguez says that "with this study we really wanted to get to the heart of this connection between ADHD and obesity. Why would there be such a connection? Especially because it can seem counterintuitive, as hyperactive children are moving around a lot and so you'd expect them to be burning calories. However, this association has been shown many times over and we wanted to understand why and

explore over time which factor is influencing which. Is it obesity that comes first or is it ADHD, or do they come together? We found that they are intertwined."

The researchers looked in detail at the genetic mechanisms at play, using individual-level, longitudinal data from Northern Finland Birth Cohort 1986. This is a pregnancy offspring cohort which follows up children at ages eight and 16, providing anonymised data including children's weight and any ADHD symptoms.

They created a polygenic risk score for children in the cohort, scoring their genetic liability to ADHD and obesity, using data from genome-wide association studies of ADHD and obesity. This analysis showed clear evidence for genetic overlap between ADHD symptoms and obesity—meaning that there are specific genetic variations that likely predispose to both conditions simultaneously.

The researchers have been following the Northern Finland Birth Cohort since pregnancy and also found evidence for an association between maternal pre-pregnancy BMI and ADHD symptoms in the child, after adjusting for underlying genetics.

More information: Ville Karhunen et al, The link between attention deficit hyperactivity disorder (ADHD) symptoms and obesity-related traits: genetic and prenatal explanations, *Translational Psychiatry* (2021). [DOI: 10.1038/s41398-021-01584-4](https://doi.org/10.1038/s41398-021-01584-4)

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