NEWS

Birth weight predicts brain size later in life, study says

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Heavier newborns have larger brains later in life, and a larger cerebral cortex — the brain region responsible for high-level functions such as consciousness and language.

The findings, published 19 November in the *Proceedings of the National Academy of Sciences* are the first to assess birth weight's connection to brain development[1].

A healthy weight for a newborn can vary widely, from about 5.5 to 10 pounds.

"We wondered whether that normal variation would have any significance" in terms of brain development, says lead investigator **Kristine Walhovd**, professor of psychology at the University of Oslo in Norway. "This study shows us that birth weight exerts a continuous influence on brain

development throughout life.”

The study tracked birth weight and brain size in typically developing infants, but a better understanding of the link between the two may shed light on why **low birth weight is a risk factor** for autism. The disorder is **five times more prevalent** in young adults who weighed 2,000 grams (about 4.4 pounds) or less at birth[2].

Low birth weight is also associated with a range of problems, including attention deficit hyperactivity disorder, schizophrenia, heart disease and diabetes.

The researchers suspected that there would be a link between birth weight and brain development for two reasons. First, as a consequence of normal genetic variation, heavier babies end up being larger adults than average.

More significantly, says Walhovd, the same conditions that cause some babies to be small, such as less blood flow to the fetus, may also affect brain development.

Growth spurt:

Walhovd and her collaborators took advantage of a database of brain images and other information compiled by the **Pediatric Imaging, Neurocognition, and Genetics** study, a multicenter effort in the U.S. to understand the genetic basis of individual differences in brain structure, connectivity, cognition and personality. The database includes magnetic resonance imaging (MRI) scans from 628 healthy individuals, ranging in age from 3 to 21 years.

The researchers looked at four measurements: total brain volume, thickness and surface area of the cerebral cortex, and the volume of the caudate nucleus, a part of the brain associated with learning and memory.

They found that total brain volume, the surface area of the cortex and caudate volume all scale with birth weight. They found no association between birth weight and cortical thickness.

“This shows that birth weight has a strong predictive value for brain growth and size at a later age,” says **Eric Courchesne**, director of the Autism Center of Excellence in the department of neurosciences at the University of California, San Diego, who was not involved in the research.

Whether the observed structural differences have any implications for cognitive function is not clear. The researchers analyzed the results of a test that assessed the participants’ cognitive control — the ability to resolve conflicting information — and found no association with birth weight.

None of the measures associated with higher birth weight — brain volume, surface area of the cortex and caudate volume — have been linked to intelligence quotients (IQs). A thicker cortex has

been linked to higher IQ, but does not appear to be associated with birth weight.

The database also includes information about the age, sex, household income and genetic ancestry of each participant, allowing the researchers to confirm that the brain differences do not result from any of those factors.

It's also unclear what the findings mean for autism. At birth, babies who go on to develop autism have an average head size, suggesting that they have normal-sized brains, says Courchesne. Research from Courchesne and others suggests that some children with autism have **larger heads than average**, and **potentially more neurons**.

However, the birth weights associated with autism risk — 4.4 pounds and under — are not represented in this study, says **Jennifer Pinto-Martin**, chair of biobehavioral health sciences at the University of Pennsylvania School of Nursing. Pinto-Martin has studied the connection between low birth weight and autism but was not involved in the new study.

The fact that individuals on the low end of normal birth weight appear to grow up healthy suggests that having a smaller brain may not automatically lead to autism, Pinto-Martin says. "It's what happens in your brain when you're small," she says. In tiny brains, "certain parts of the brain are compressed, and this might interrupt connections and have long-term effects."

References:

1: Walhovd K.B. *et al*. *Proc. Natl. Acad. Sci. USA* Epub ahead of print (2012) **PubMed**

2: Pinto-Martin J.A. *et al. Pediatrics* **128**, 883-891 (2011) **PubMed**