

Better Blood Sugar Control in Teens May Limit Diabetes-Related Brain Damage

Harm to Brain May Be Reversible, Study by Nemours Children's Health, Jacksonville and Stanford University Suggests



JACKSONVILLE, Fla. (Aug. 30, 2022) – Tight control of blood sugar in teens with Type 1 diabetes may help reduce the disease's damaging effects on the brain, effects which have been shown even in younger children, according to a study published online today in *Nature Communications*. The findings indicate that better glucose control can actually improve brain structure and function in youth with Type 1 diabetes, bringing them closer to their peers without diabetes, investigators said.

This proof-of-concept pilot study – the most detailed to date on this topic – was jointly led by investigators from Nemours Children's Health, Jacksonville and Stanford University School of Medicine.

"These results offer hope that harm to the developing brain from Type 1 diabetes might be reversible with rigorous glucose control," said the paper's senior author, and co-principal investigator, pediatric endocrinologist [Nelly Mauras, MD](#), of Nemours Children's Health Jacksonville and professor of pediatrics at Mayo Clinic College of Medicine. "Use of an automated hybrid closed-loop system--an insulin delivery system linked to a continuous glucose monitor--was associated with better blood glucose concentrations, which translated in our study to quantifiable differences in brain structure and cognition."

The study was conducted through the five-center Diabetes Research in Children Network (DirecNet). Funded by the National Institutes of Health (NIH), DirecNet has longitudinally followed a cohort of children with and without diabetes for nearly eight years. DirecNet studies have added to evidence that children and teens with diabetes undergo detrimental changes in the brain – with effects including below-normal IQ – and that these differences are linked to high blood sugars.

Dr. Mauras and the DirecNet investigators recruited 42 adolescents, aged 14 to 17 years, diagnosed with Type 1 diabetes before the age of eight who were receiving insulin therapy. The teens were randomized to one of two groups – one using a hybrid closed-loop insulin delivery system and the other receiving standard diabetes care. The researchers conducted cognitive assessments and multi-modal brain imaging with all participants before and after the six-month study period.

A hybrid closed-loop insulin delivery system, used properly and continuously, can increase the amount of time when blood sugar is in a healthy range. It particularly helps stabilize blood sugar during sleep, when detection and treatment of early signs of hypoglycemia are more difficult. The system uses a closed glucose monitor (CGM) to measure blood sugar every five minutes through a sensor under the skin. The CGM connects wirelessly to an insulin pump that adjusts the amount of insulin based on the latest CGM reading.

Participants using the closed-loop glucose control system showed significantly greater improvement than the standard care group in key brain metrics indicative of normal adolescent brain development – in other words, their results were closer to those of teens without diabetes. The closed-loop group also showed higher cognitive (IQ) outcomes and functional brain activity, more in line with normal adolescent brain development.

"We have known for some time that better control of blood glucose levels in persons with Type 1 diabetes can prevent or reduce damage to a number of biological systems (for example, kidney, eyes, nerves, blood vessels). Our new research joins with other studies to highlight that better control of blood glucose levels in children with Type 1 diabetes can potentially reduce

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injury to the maturing brain and lead to measurable improvements in brain development and function as well,” said lead author and co-principal investigator, [Allan Reiss](#), MD, the Howard C. Robbins Professor of Psychiatry and Behavioral Sciences and a professor of radiology at Stanford.

Type 1 diabetes is an autoimmune disease, in which the body’s immune system mistakenly destroys insulin-producing cells in the pancreas. Its causes are not fully understood, and currently no cure exists. An estimated 244,000 children and adolescents in the U.S. have this condition, which can cause sometimes serious health problems that develop quickly or that show up later in life. This study builds on previous research showing that strict blood sugar control leads to lower rates of diabetes complications such as blindness, kidney failure, and amputations.

This research was supported by grants from the NIH Eunice Kennedy Shriver National Institute of Child Health and Human Development (Grant 5R01-HD-078463) and a grant from the Juvenile Diabetes Research Foundation. Other investigators at Nemours participated in the project (Larry Fox, MD, Allison Cato, PhD, Keisha Bird DNP and Kim Englert, RN). Researchers at Stanford University (Bruce Buckingham, MD), Washington University in St. Louis (Neil White, MD), the University of Iowa (Eva Tsalikian, MD), Yale University (Stuart Weinzimer, MD) and the Jaeb Center for Health Research (John Lum) also contributed to the project.

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About Nemours Children's Health

Nemours Children's Health is one of the nation's largest multistate pediatric health systems, including two free-standing children's hospitals and a network of more than 70 primary and specialty care practices. Nemours Children's seeks to transform the health of children by adopting a holistic health model that utilizes innovative, safe, and high-quality care, while also caring for the health of the whole child beyond medicine. Nemours Children's also powers the world's most-visited website for information on the health of children and teens, KidsHealth.org.

The Nemours Foundation, established through the legacy and philanthropy of Alfred I. duPont, provides pediatric clinical care, research, education, advocacy, and prevention programs to the children, families, and communities it serves.

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