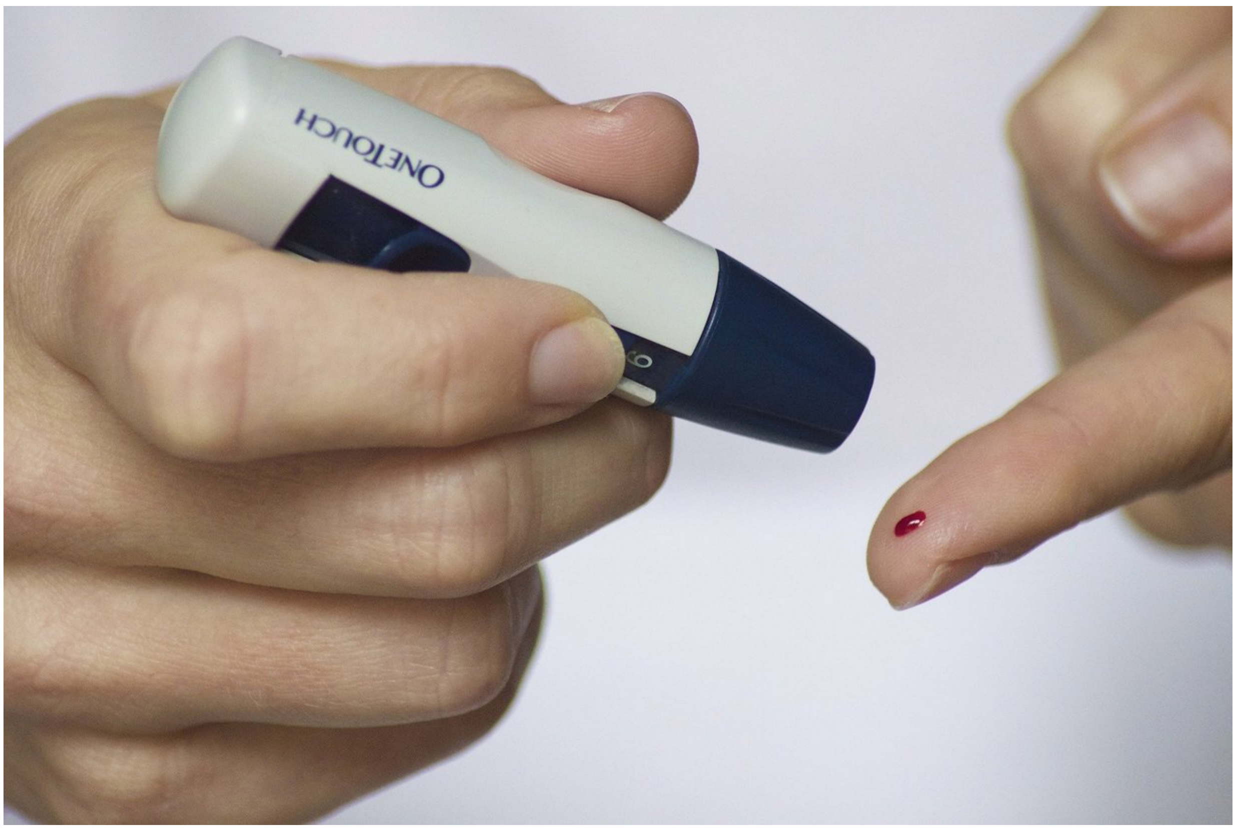
Brain function irregular in children with type 1 diabetes, study says

December 10 2019, by Erin Digitale



Credit: CC0 Public Domain

Children with Type 1 diabetes show subtle but important differences in brain function compared with those who don't have the disease, a study led by researchers at the Stanford University School of Medicine has shown.

The study, published online Dec. 9 in *PLOS Medicine*, is the first to evaluate what happens in the brains of children with diabetes during a cognitive task. On functional magnetic resonance imaging scans, when their brains were at work, children with diabetes displayed a set of abnormal brain-activity patterns that has been seen in many other disorders, including cognitive decline in aging, concussion, attention-deficit hyperactivity disorder and multiple sclerosis.

The study also reported that the abnormal brain-activity patterns were more pronounced in children who had had diabetes longer.

"Our findings suggest that, in children with Type 1 diabetes, the brain isn't being as efficient as it could," said Lara Foland-Ross, Ph.D., senior research associate at the Center for Interdisciplinary Brain Sciences Research at Stanford. Foland-Ross shares lead authorship of the paper with Bruce Buckingham, MD, professor emeritus of pediatrics at Stanford.

"The takeaway from our study is that, despite a lot of attention from endocrinologists to this group of patients, and real improvements in clinical guidelines, children with diabetes are still at risk of having learning and behavioral issues that are likely associated with their disease," said the study's senior author, Allan Reiss, MD, professor of psychiatry and behavioral sciences at Stanford.

Blood sugar affects brain development

Type 1 diabetes occurs when the pancreas fails to make insulin, a hormone that helps regulate blood sugar. Patients are given insulin via injections or an insulin pump. But even with treatment, their blood levels of glucose, the main sugar in blood, fluctuate much more than in healthy individuals.

"Kids with diabetes have chronic swings in blood-glucose levels, and glucose is important for brain development," Foland-Ross said. Brain cells need a steady supply of glucose for fuel. Earlier work revealed brain-structure changes and mild performance impairment on cognitive tasks in children with Type 1 diabetes, but the mechanism had never been studied. "It was important to capture what is going on in the brains of these kids functionally," she said.

The researchers conducted fMRI brain scans on 93 children with Type 1 diabetes recruited at five sites: Nemours Children's Health System in Jacksonville, Florida; Stanford; Washington University in St Louis; the University of Iowa; and Yale. An additional 57 children who did not have the disease composed the control group. All participants were 7-14 years old. Standard behavioral and cognitive tests were given to all the children before brain scanning.

Then, in the fMRI scanner, the children performed a cognitive task called "go/no-go": Different letters of the alphabet were shown in random order, and participants were asked to press a button in response to every letter except "X." The task is often used in brain-scanning studies to evaluate what is happening in the brain while participants are concentrating.

The study found that, although the children with diabetes performed the task as accurately as those in the control group, their brains were behaving differently. In children with diabetes, the default-mode network, which is the brain's "idle" system, was not shutting off during the task. To compensate for the abnormal activation of the default-mode network, the brain's executive control networks, responsible for aspects of self-regulation and concentration, were working harder than normal in the children with diabetes.

These abnormalities were more pronounced in children who had been diagnosed with diabetes at younger ages, suggesting that the problem may worsen with time.

"The longer the exposure you have to dynamic changes in blood-glucose levels, the greater the alterations in brain function with respect to the default-mode network," Foland-Ross said. Studies in adults with diabetes suggest that in the later stages of the disease, the brain eventually loses its ability to compensate for this problem, she added.

Next: Testing effects of devices

Next, scientists want to study whether achieving better blood glucose concentrations through treatment with a closed-loop artificial pancreas benefits children's brain function. These devices electronically couple a blood glucose sensor to an insulin pump that automatically adjusts insulin delivery.

"We hope that with improvements in devices for diabetes treatment, these findings will either decrease in severity or go away," Reiss said, adding that with better blood sugar control, children's brains might be able to recover normal activity. "Young brains have the most potential for plasticity and repair," he said. "But children also have a long time to live with the consequences if problems with brain function persist."

More information: Lara C. Foland-Ross et al. Executive task-based brain function in children with type 1 diabetes: An observational study, *PLOS Medicine* (2019). DOI: 10.1371/journal.pmed.1002979

Provided by Stanford University Medical Center

Citation: Brain function irregular in children with type 1 diabetes, study says (2019, December 10) retrieved 25 April 2024 from https://medicalxpress.com/news/2019-12-brain-function-irregular-children-diabetes.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.