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**Warning! Junk foods can harm a teen’s brain**

By Sharon Oosthoek, Science News for Students

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"You are what you eat." When people say that, they mean a healthy diet can boost your health. But the opposite is also true. In fact, if you're between the ages of 10 and 19, eating too much junk food can harm your body and your brain.

Junk food shapes adolescent brains in ways that impair their ability to think, learn and remember. It can also make it harder to control impulsive behaviors, says Amy Reichelt. It may even up a teen's risk of depression and anxiety, she notes.

Reichelt is a brain and nutrition specialist at Canada's Western University in London, Ontario. Adolescents are more sensitive than any other age group to foods with a lot of processed fat and sugar, she says. She is part of a group of scientists around the world who have been studying why.

She and two other researchers at Western recently reviewed more than 100 studies (including their own) about how poor food choices can impact adolescent brains. They described what they learned in the May issue of *The Lancet Child* and *Adolescent Health.*

One problem: Adolescent brains are not yet fully formed. And that actually leads to three problems in one, says Reichelt. First, adolescent brains are still developing the ability to assess risks and control actions. Second, teen brains get more pleasure than adult brains do from rewarding behaviors such as eating junk food. Third, adolescent brains can be more easily influenced by their environment, and this can include any stress you're feeling, any isolation or any drugs you may be taking. It can also be influenced by diet. Together, these all can combine to make junk food both hard to resist and extra bad for teen health.

**Brains under Construction**

Let's break that down, starting with preteen and teen behaviors. The brain region that tells us we shouldn't eat chips all the time — and helps us resist that urge — is the last to mature. Called the prefrontal cortex, this region doesn't fully develop until we are in our early 20s.

Brain imaging studies show that the prefrontal cortex turns on when we weigh risks and make decisions about how to act.

"Most of our complex brain functions happen in the prefrontal cortex," says Reichelt. This includes complex math and reading, but she notes that it also includes "how to assess risky behavior."

At the same time, teen brains get more buzz from rewards. Unlike the prefrontal cortex, the parts of the brain that make us feel good when we do something pleasurable — like eating tasty foods or being with friends — are fully developed by the teen years.

In fact, these regions are even more sensitive when we are young. That's because of a natural chemical called dopamine. Dopamine is sometimes called the "feel good" chemical, and it lifts our mood when we experience something rewarding. And it is especially active in adolescent brains.

As a neurotransmitter, it zips across the spaces between brain cells. Once it arrives at a new cell, dopamine binds to docking stations there. These molecules are known as receptors. When dopamine docks, those receptors relay the "feel good" signal from the last cell to this new one, and that tells the brain that whatever it just experienced is worth getting more of. Adolescents have more dopamine receptors in the brain than do adults, so they get more good vibes from anything they find enjoyable.

The teen brain, thus, has two strikes against it when it comes to resisting junk food. "It has a heightened drive for rewards and reduced self-regulation," says Reichelt.

That's a big problem for adolescents because of the third issue: Growing brains can be more easily changed by eating high-fat, high-sugar foods. That's what Reichelt and her team discovered in their studies of "teenage" mice.

**Mouse Brains on Fat and Sugar**

Since mouse brains develop very much like our own, they can be used to understand how what we eat affects the human brain. In 2017, Reichelt was part of a team that fed adolescent mice high-fat foods to see how it affected their brains.

One group of mice ate a diet in which 63 percent of their calories came from fat. (That's a *lot* of fat. It would be like eating bacon cheeseburgers and ice cream every day.) A second group ate a healthy diet.

As expected, mice eating high-fat food gained weight and put on body fat. But that was not all. These mice also performed worse on memory tests than did mice eating a normal diet.

The researchers tested the mice for what's known as working memory. It's the type that allows us to hold on to information long enough to use it. For example, working memory helps you remember which five things you need to buy at the store. Or what time you said you'd meet your friends. It's also important for reasoning and decision-making. And it involves the prefrontal cortex — that's the same brain area that helps make decisions.

Reichelt and her team used two different tests to gauge this working memory. In the first, they put the animals in a Y-shaped maze. Each mouse started in the center of the Y shape. From there they were free to explore two of the three arms of the maze. The third arm was blocked off.

Then the researchers opened up the maze's third arm. Mice will naturally explore their environment and are drawn to new things. Given the chance, they should prefer to visit a new arm of the maze rather than one they've already explored. Or they would if they could remember which arms of the maze they had already visited.

Mice eating a healthy diet behaved as expected. They chose to explore the new arm of the maze. But those eating a high-fat diet did not prefer any one arm. The fact that they explored all three at random seemed to show they could not remember which parts of the maze they had seen already.

The second test used a maze set up in a tank of murky water. The end of the maze is a platform just under the water's surface. To get out of the water, a mouse must navigate to the platform by remembering landmarks. (The mice are scooped up to avoid drowning if they can't find their way.)

Mice fed a healthy diet performed much better than did those eating high-fat chow. The fatter mice were just as good at swimming; they just did not find their way to the platform. This suggests they could not remember the landmarks.

Then the researchers looked at the animals' brains. Here they found important differences in reelin, a chemical that helps brain cells chat with each other. Mice on high-fat chow had roughly 35 percent less reelin in their prefrontal cortex compared to mice on a healthy diet. The high-fat diet may have made the prefrontal cortex in these mice work less effectively.

People with brain diseases (such as schizophrenia and bipolar disorder) often have lower levels of reelin, too, says Reichelt. "We can't blame that on junk food in adolescence," she says. "But it may be a contributing factor [to risk of disease]."

**Please respond:**

1. **According to this text, what are the three problems with the adolescent brain that makes junk food both hard to resist and extra bad for teen health?**
2. **Using evidence from this text, explain what the prefrontal cortex does:**
3. **Using evidence from this text explain what the natural chemical dopamine is and what it does to the brain:**
4. **According to this text, what are the two strikes the teen brain has against it?**
5. **Using evidence from this text, explain what a working memory is:**
6. **According to this text, identify and then explain the two tests researchers used on their teenage mice to test their working memory:**
7. **Using evidence from this text, explain what you think the author wanted you to learn:**