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SWEET AND LOW

Brittney Saline details how exercise and healthy eating might be the best way to combat sugar-fueled depression.

BY BRITTNEY SALINE

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Roxanne Melillo formerly used sugar as comfort food. After altering her diet and starting CrossFit, she's lost 10 sizes and said she feels far better.

"Open happiness." —The Coca-Cola Co.

America has a happiness problem, and Coca-Cola's got the answer.

On the multi-billion-dollar beverage company's website, the brand juxtaposes the words of Aristotle, Mahatma Gandhi, Buddha and others with the prose of its marketing team: "Open an ice cold Coca-Cola and choose happiness!"

It didn't work so well for Roxanne Melillo. A survivor of childhood domestic violence and sexual abuse, the 39-year-old has spent her life sugarcoating her pain.

"I ate to heal myself," Melillo said. "I would get into a bad mood and the first thing I would turn to is a soda and a candy bar."

Snickers bars were her feel-good food, a glistening can of Coke her elixir.

"It was a quick fix," she said. "Pop the can open, drink it."

It made sense. After all, sugar mediates the release of dopamine, a neurotransmitter that activates reward signals in the brain. Despite her self-medication, Melillo grew heavier, not happier. By 36, she was pushing 300 lb. at an even 5 feet and had stopped socializing.

"I didn't care; (sugar) kept me in a cloud of no reality," she said.

She's not the only one with a sugar problem. In 2013, the average American consumed approximately 22 teaspoons of caloric sweeteners per day, according to United States Department of Agriculture (USDA) data. Meanwhile, an estimated 350 million people suffer from depression worldwide, according to the World Health Organization, which dubs depression the world's "leading cause of disability."

It's not for lack of drugs. One in 10 Americans 12 and older takes antidepressant medication, according to the Centers for Disease Control and Prevention (CDC), spending more than US$11 billion on antidepressants in 2010 alone.

"The rate of antidepressant use has more than tripled in the past 25 years, and yet, if anything, the overall rate of depression is higher now than it was back then," said Stephen Ilardi, a Kansas University psychology professor who holds a doctorate in clinical neuroscience. "Everything that we're throwing at this epidemic is really barely making a dent."

So why are we so unhappy?

Sweet (Dis)Satisfaction

Sugar makes us feel good. Just look to any romcom—full of broken hearts and empty ice-cream tubs—for proof. But research suggests sugar is more sinister than soothing—and not just for our waistlines.

A 2002 study by researchers from Baylor College of Medicine in Houston, Texas, analyzed major depression prevalence alongside refined-sugar-consumption data across the United States, Korea, France, Germany, Canada and New Zealand. The authors found a "highly significant correlation between sugar consumption … and the annual rate of depression."

Researchers from the University of Adelaide in South Australia got a bit more specific, linking soft drinks and sports drinks—including Gatorade and Powerade—to depression and suicidal thoughts in a 2010 survey of nearly 5,000 people.

One year later, scientists from the Jiangsu Provincial Center for Disease Control and Prevention in Nanjing, China; the Eunice Kennedy Shriver National Institute of Child Health and Human Development in Bethesda, Maryland; and the University of Adelaide conducted a similar study of almost 24,000 students aged 12-19, examining the association between soft-drink consumption and suicidal thoughts. The researchers reported an 80 percent increased risk for suicidal plans among those who consumed soft drinks three times per day compared to those who imbibed less than once. The risk of an actual suicide attempt nearly quadrupled.

While sugar-sweetened beverages are the leading source of calories from added sugar in the average American diet, it's not just drinks that are making us sad. Caloric sweeteners are hidden in 77 percent of calories purchased from consumer-packaged goods in the U.S.

James Gangwisch is a psychotherapist at Columbia University in Manhattan. Remembering his own childhood tendency to feel melancholy after eating sweets, he wondered if he ate sugar because he was sad or if he was sad because he ate sugar.

"We already know that people who are depressed have a tendency to crave carbohydrates and to crave sweets," he said. "So we wanted different sources of evidence to see if excess sugar intake or excess carbohydrate intake is a risk factor for depression—could it increase your chances of developing depression?"

Using data from the Women's Health Initiative, Gangwisch and researchers from major universities in California, New York and Minnesota analyzed the food intake and depressive symptoms of nearly 70,000 postmenopausal women for a three-year period, paying attention to total dietary glycemic index (GI) and added sugars. None of the women were depressed at the start of the study, but after three years, the women who reported the most depressive symptoms were also the ones with the highest overall dietary GIs, researchers reported.

Gangwisch theorized that one explanation for the link between a higher dietary GI and depression is repeated spikes and dips in blood-glucose levels, which, over time, can reduce the amount of glucose transported to the brain and result in fatigue, anxiety and mood impairment.

Regular excessive sugar intake can also lead to chronic inflammation, the result of continually overwhelming the liver with fructose.

"Sugar promotes inflammation, and as a pithy way of putting it, the inflamed brain is a depressed brain," Ilardi said.

On a local level—think bug bites and sprains—inflammation is a good thing, enriching the site with restorative hormones and chemicals in the blood.

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>
> —Stephen Ilardi

Brittney Saline

When Hippocrates said, "Let food be thy medicine," it's likely he was referring to wholesome, nutritious food rather than brightly colored handfuls of sugar.

Jessica Kanoski

"What you're eating is important independent of the total amount of calories." —Scott Kanoski

"But if we have a systemic inflammatory response then now we have these inflammatory hormones out in the bloodstream at a high level," Ilardi continued, "and they generally tend to suppress activity in circuits that use serotonin, many circuits that use dopamine, and, in particular, dopamine-based circuits that give us a sense of initiative and drive to pursue our goals and (take) pleasure in reward-based activity."

But inflammation is just one way sugar damages our brain. The sweet stuff we crave when we're feeling down can actually scramble our genetic hardwiring for happiness.

Head Games

Blue eyes or brown, male or female—our genes determine how we look and which diseases we're susceptible to. They also determine production of brain-derived neurotrophic factor (BDNF), a protein that enhances brain health and neuroplasticity by regulating the growth and survival of neurons and synapses.

BDNF plays a vital role in learning and memory, and a lack of it has been linked to Alzheimer's disease and major depression. Common antidepressants such as selective serotonin reuptake inhibitors (SSRIs) and norepinephrine selective reuptake inhibitors (NESRIs) have been shown to upregulate BDNF expression, and BDNF serum infusions to rodent brains have demonstrated antidepressant effects.

Moreover, postmortem analyses of human hippocampi have revealed decreased BDNF expression in suicide patients.

Our natural expression of this protein is determined by the BDNF gene, of which there are multiple variants, some associated with impaired or reduced BDNF secretion. The good news is that we have the power to affect the expression of our genetics.

"Just because you have one gene variant doesn't mean that we can't yet influence the functioning of that particular gene," said Kirk Erickson, a psychology professor at the University of Pittsburgh. "And so exercise, diet, intellectual engagement—we know that all of these things seem to increase the amount of BDNF. Even if you have the 'bad' gene for BDNF, there might be something that we can do about it."

The first thing we can do is to eat less sugar. Studies published in Neuroscience and Hippocampus reported that rodents fed diets high in saturated fat and refined sugar exhibited reduced levels of BDNF as well as hippocampal atrophy. Scott Kanoski, an assistant professor at the University of Southern California with a doctorate in behavioral neuroscience, published one such study in Behavioural Brain Research in 2007, and he was curious to find out whether sugar had an independent effect on BDNF expression.

In February 2015, he published a study detailing the effects of sucrose and high-fructose-corn-syrup consumption on spatial memory function and hippocampal inflammation in adolescent rats, as compared to control groups fed a standard chow. Both groups weighed the same at the end of the study, but the sugar-stuffed rats demonstrated neuroinflammation and impaired cognitive function.

"If you look at those data, it really speaks to the fact that what you're eating is important independent of the total amount of calories," Kanoski said.

Researchers are not entirely sure as to why sugar damages the hippocampus and impairs BDNF expression, but they are certain that it does.

"We know that these diets lead to inflammation in these neurons, so that could be one mechanism that ultimately leads to lower expression of BDNF," Kanoski said.

The implications for people at risk for or fighting depression are significant.

"BDNF is critical to all new learning," Ilardi said. "So when a person is stuck in depression, in order to get un-depressed, they need to have a lot of BDNF to learn that 'OK, I don't need this runaway stress response, and the world around me isn't horrible, and people really don't hate me, and life really is worth living' … so if they're eating a lot of sugar, it can actually get in the way of that healing process."

Tire-Flip Therapy

Like many eighth-grade boys, Conor Chisholm often faked the stomach flu to get sent home from school early. Only he didn't do it for the thrill of playing hooky.

"It was because of my anxiety," said Chisholm, now 18. "I would just feel anxious, and kind of sad, for no reason."

At 6, Chisholm was diagnosed with depression, ADHD and anxiety. Though he played hockey from third to sixth grade, in seventh grade he often blew off practice, eventually quitting because of his anxiety. In his eighth-grade year, he transferred from public school to a private therapeutic school.

Chisholm tried hobbies such as skateboarding and drawing and took medicine for his conditions, regularly seeing a psychologist. Still, sweets were the only thing that made him feel better.

"Back then if I would eat a bunch of ice cream at night while watching TV, everything would feel so much better," he said. "Then when I'd wake up in the morning, and that's when I wouldn't feel that great."

Then his father got hooked on CrossFit.

"I remember he would always be on the CrossFit website looking at the workouts and exercise demos," Conor said. His mother, Caitlin, followed suit, attending a Level 1 Certificate Course a year later.

One day, Caitlin brought Conor to the gym.

"I had such bad anxiety that I didn't really want to go anywhere … but my mom just kind of made me go," Conor said.

But flipping huge, dusty tractor tires and doing heavy farmers carries with old torpedo shells changed his outlook.

"Right after the workout I asked my mom if I could go every day," Conor said.

We've Got the Power

What if we could change our brain chemistry?

"The cells, including neurons, in animals on high-energy diets, their adaptive stress-response pathways are not activated regularly because they have a constant supply of energy," said Mark Mattson, a senior investigator at the National Institutes of Health. "They're essentially not challenged."

When we exercise, however, we give our cells the challenge modern-day life has squelched, activating signaling pathways that lead to the expression of genes encoding proteins designed to protect cells against stress.

"And one of those proteins is BDNF in the brain," Mattson said.

Other environmental factors such as sunlight, calorie restriction, and learning and memory tasks, Mattson said, can positively contribute to BDNF expression. But, he added, "Of all the environmental stimuli that increase BDNF, exercise is the most potent."

In a 2002 study, researchers from the University of California, Los Angeles and the Brain Research Institute in Los Angeles tested levels of BDNF protein and its receptors in rats after three days of voluntary wheel running. Compared to a sedentary control group, BDNF-receptor levels in the soleus muscle increased 391 percent after three days of exercise, and BDNF-protein levels increased 204 percent. Levels of each were also increased in the spinal cord.

In a test of opposites, the researchers paralyzed the soleus muscles of a separate group of sedentary rats caged in conditions "analogous to the sedentary life of many humans." Paralyzed for approximately eight days, the rats showed a 77 percent reduction in BDNF receptor levels in the soleus muscle and an 86 percent reduction in the spinal cord. After the rats were given seven days to exercise, those numbers increased 175 and 142 percent, respectively.

In 2011, Erickson tested the theory on older adults. In a yearlong controlled trial with 120 adults aged 55-80, participants walked for 40 minutes weekly. Erickson and his team reported that the year of training led to a 2 percent increase in hippocampal volume, writing that, "We also demonstrate that increased hippocampal volume is associated with greater serum levels of BDNF."

"We actually don't have a good understanding of exactly why exercise has this promoting effect, but it certainly seems that when we exercise, it increases the expression of a whole variety of genes … and within that bundle of genes, BDNF seems to be one of them," Erickson said.

Though most studies have examined the relationship between BDNF and strictly aerobic activities, a 2010 study by researchers from the universities of Florida and Georgia demonstrated that "short-duration resistance exercise augments serum BDNF concentrations and that regular participation in progressive resistance training elevates the circulating BDNF response to exercise."

After an experiment wherein 20 healthy, previously untrained males trained the squat and bench press with increasing loading over a five-week period, the change in BDNF levels from rest to immediately post-exercise increased 98 percent from baseline levels.

"Overall, our results indicate that resistance training increases circulating BDNF, similar to the effects of endurance exercise," the researchers wrote.

The Way We Live

Today, Chisholm is in his senior year of high school. After more than three years of attending CrossFit classes at CrossFit Magnitude in Pembroke, Massachusetts, and CrossFit Marshfield in Marshfield, Massachusetts—along with eliminating most of the sugar from his diet—Chisholm

Conor Chisholm struggled with anxiety and depression but was able to come off his medication after eating better and committing to a fitness regime.

Courtesy of Caitlin Chisholm

Abby Ilardi

Stephen Ilardi is a professor of psychology at Kansas University and holds a doctorate in clinical neuroscience.

said anxiety and mood swings are significantly reduced. He has returned to public high school and works part time at a grocery store.

"I feel so much better compared to how I felt before," he said. "I feel more balanced … like in the same mood the whole day."

In August 2014, he met with his doctor.

"I told the doctor, 'I don't think I need to be on meds anymore because all I need to do to feel good at school is have a good routine with clean eating and going to a CrossFit class every day,'" he said. "And I haven't taken any medicine since."

Melillo started CrossFit in August 2014 at the insistence of her cousin, Lauren Plumey, who owns Shoreline CrossFit in Branford, Connecticut. One month later, Melillo joined the affiliate's Paleo challenge, eliminating all sugar from her diet. In addition to dropping from a size 24 to 14 in six months, the combination of CrossFit and the Paleo Diet "changed my life," she said.

She added: "I was very clear headed, very focused. My kids were happier. I was happier."

Though she suffered a short relapse following the death of her grandfather later that year, a combination of therapy, a low dose of antidepressants, CrossFit and a clean diet have her back on track today.

> "Exercise changes the brain and diet changes the brain."
>
> —Stephen Ilardi

"I don't have the anxiety I was having initially," she said. "I don't have depressive mood swings or anything."

According to Ilardi, that combination is what we need to see more of in the fight against depression.

"We can't keep simply throwing medication at the depression epidemic and expect to help it," he said. "Just like we wouldn't take a patient who just had a heart attack and just throw medication at them, and say 'OK, you can continue living exactly the way you've always been living.'"

He continued:

"I think with depression, the first point of emphasis should not be the medication. It should be, 'We need to radically change the way you're living.' Why? Because exercise changes the brain and diet changes the brain … . Affirming that depression is characterized by a chemical imbalance tells us nothing about the most effective way of treating it.

"And it turns out that there are literally dozens of ways of changing neurochemistry. And most of them have nothing to do with medication and everything to do with the way we live." ■

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Brittney Saline contributes to the CrossFit Journal and the CrossFit Games website. She trains at CrossFit St. Paul.

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