

Weight Loss, Cortisol, and Your Brain

Scientists Explore Connections



PEGGY GREB (D2802-1)

Americans everywhere are struggling to lose weight—and to keep from putting those lost pounds right back on. For many, it's discouraging to have their best efforts fail while those of other dieters succeed.

Researchers at the Agricultural Research Service's Western Human Nutrition Research Center in Davis, California, are conducting studies that may provide new insights into the underlying causes of this disparity in dieting success.

Given America's obesity epidemic, such research is timely and relevant. The U.S. Centers for Disease Control and Prevention estimates that 35 percent of U.S. adults and 18 percent of kids and adolescents age 6 through 19 are overweight or obese. Both conditions are associated with increased risk of type 2 diabetes, cardiovascular disease, and other chronic disorders.

Nutrition scientist Kevin Laugero and biologist Rashel DeCant observe data that show a correlation between brain function and amount of weight lost.

Chemist Nancy L. Keim, nutrition scientist Kevin D. Laugero, and their colleagues have looked at several factors that may affect weight-management success. Their analysis included assessing volunteers' patterns of decisionmaking and evaluating changes in their levels of cortisol—a stress-associated hormone.

The study volunteers, 29 obese but otherwise healthy women age 20 to 45, were asked to eat all their meals at the nutrition center, where their food was prepared for them.

The research began with a 3-week baseline phase, during which the intent was to stabilize the volunteers' weight. That was followed by a 12-week reduced-calorie regimen intended to help the volunteers shed pounds. During this weight-loss

phase, meals provided 500 fewer daily calories than the total each volunteer would have needed if the goal had been to maintain her weight.

Two exceptions to this outline were built into the study: During each of the two study phases, volunteers had an "all you can eat" evening meal. These buffet dinners were provided for each volunteer to eat privately, to help rule out the effect that social pressure might have on what, and how much, the volunteer chose to eat.

Weight Loss Differs

The amount of weight lost and the amount lost as fat instead of lean (muscle or bone) varied widely among the volunteers. Says Keim, "The variation occurred even though volunteers were essentially provided the same foods and were each shorted

500 calories a day during the weight-loss phase—with the exception of the buffet dinner.” Volunteers lost anywhere from 0 to 27 pounds.

This variation, along with findings from many other weight-management clinical trials conducted elsewhere, suggests that tomorrow’s weight-loss strategies “may need to be even more individualized to be more successful,” Keim says.

Dieting and Decisionmaking

For many people, dieting “involves an ongoing series of decisions,” Keim notes. “We wanted to get a snapshot of volunteers’ patterns of decisionmaking.”

To do this, the researchers selected the Iowa Gambling Task, or IGT, a test that is widely used to evaluate what’s known as “executive function.” This umbrella term encompasses decisionmaking, differentiating good from bad, being cognizant of the potential future consequences of current actions, and resisting the temptation of short-term, immediate rewards in favor of long term benefits.

These functions are thought to be handled in a region of the brain known as the “prefrontal cortex.”

During the IGT test, volunteers had a limited amount of time to choose cards from among four decks displayed face down on their computer screen. Each card offers, in “play” money, a monetary penalty and a monetary reward. As the test progresses, players can learn to distinguish a “good” from a “bad” deck in terms of the risks and rewards offered, and they can modify their future choices accordingly—or not.

“We found that the volunteers who lost the most weight had the highest IGT scores,” Keim says. “To the best of our knowledge, this study is the first controlled-feeding weight-loss trial to report an association between diet-induced weight loss and performance on the IGT.”

“The application of the IGT is really in its infancy in terms of decisionmaking about food—and eating in general. We intend to continue to use this test in studies that are designed to delve into how people make decisions about what they eat.”

Cortisol Concentrations Increase

To learn more about volunteers’ cortisol levels, the scientists collected saliva

samples throughout the day on two test dates, one near the beginning of the weight-loss regimen and one near the end.

“Increases in cortisol concentration have long been regarded as a reliable indicator of psychological stress, even though those increases can also be caused by other factors,” says Laugero. “Stress is considered to be a contributing factor to dieters’ relapsing back to old eating habits and regaining weight.”

“We found that our volunteers’ cortisol concentrations generally increased from the beginning to the end of the reducing-diet phase of the study. Dieting may have been stressful for them. They were experiencing an element of outside control over what they ate, in that we asked them to eat only the foods that we offered them. Also, each dieter had to exercise restraint for 12 weeks, except perhaps during the buffet meal. That’s a relatively long time.

“In addition to its association with stress, cortisol is thought to affect our eating habits and how our bodies metabolize fat,” Laugero points out. “Some animal studies suggest that cortisol contributes to obesity, but the association remains unclear and controversial.”

Cortisol Levels Compared to IGT Scores

In another analysis of the cortisol data, the scientists found that volunteers whose cortisol levels had increased the most were those with the lowest IGT scores.

“The IGT has been used in earlier research concerning eating disorders and obesity,” Laugero says, “but our study is apparently the first weight-loss trial of its kind to report an association between

cortisol concentrations and IGT scores.” Says Laugero, stress is “already known to have a degrading effect on regions of the brain, including the prefrontal cortex, that are involved in decisionmaking.”

Perhaps most interesting of all, the prefrontal cortex is also involved in releasing cortisol. “Some cross-talk that we don’t fully understand may be taking place,” says Laugero. “A better understanding of that communication may lead to successful, science-based strategies for reaching and maintaining a healthy weight.”

Everyone, not just dieters, might benefit. Obesity adds an estimated \$190 billion to the nation’s annual healthcare costs.

Keim and Laugero, who are with the ARS Obesity and Metabolism Research Unit, collaborated in the study with unit physiologists Sean H. Adams and Marta D. Van Loan and postdoctoral researcher Megan G. Witbracht of the University of California-Davis Department of Nutrition.

The study was part of a larger investigation headed by Van Loan. A peer-reviewed article in *Physiology and Behavior* documents the investigation.—By **Marcia Wood**, ARS.

This research is part of Human Nutrition, an ARS national program (#107) described at www.nps.ars.usda.gov.

*Nancy L. Keim and Kevin D. Laugero are with the USDA-ARS Western Human Nutrition Research Center, Obesity and Metabolism Research Unit, 430 W. Health Sciences Dr., Davis, CA 95616; (530) 752-4163 [Keim], (530) 752-4173 [Laugero], nancy.keim@ars.usda.gov, kevin.laugero@ars.usda.gov. **

Postdoctoral researcher Megan Witbracht (left) instructs a study volunteer (right) on an end-of-study test of brain function while chemist Nancy Keim answers questions that come up.



PEGGY GREB (D2801-1)