

UNH Research Shows that Over-eating Makes It Harder to Burn up Fat through Exercise

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DURHAM, N.H. -- You've pigged out on that holiday dinner. No sweat, you'll just head to the gym to work it off. Right? Wrong. Research by a University of New Hampshire nutritional biochemist shows that overindulgence at the dinner table actually makes it harder to burn up fat through exercise.

Fat cells, the storage tanks of the body's energy supply, hoard excess calories until the muscles need them. When we exercise, they become more sensitive to the hormones being released -- such as epinephrine -- that tell them to release their contents.

"This process, called lipolysis, provides needed fuel for movement, shrinks the cell and reduces body fat," says Gale Carey, UNH associate professor of animal and nutritional sciences.

Adenosine, a natural hormone, is believed to slow the breakdown of fat to ensure our fuel supplies are rationed efficiently. Exercise, however, dampens the cells' response to adenosine by reducing the number of receptors this hormone needs to bind onto, as Carey first demonstrated in 1994.

Her newest study, published in the *Journal of Applied Physiology*, looks more closely at this cellular mechanism by adding diet to the equation. Carey wanted to know how a diet high in calories, but low in fat, would affect fat metabolism. She also wanted to figure out the mechanism that eliminates some adenosine-binding receptors.

Carey conducted her research with the help of 24 miniature swine. The animals are excellent models because their metabolism resembles that of humans. They also can provide blood and tissue samples without compromising their health.

Six sets of four sibling pigs with similar genetic backgrounds were divided into four groups: "restricted-fed sedentary," "restricted-fed exercised," "full-fed sedentary," and "full-fed exercised." The exercised pigs

were trained to run on a treadmill for 45 minutes five days a week, while the pigs on a restricted diet were fed 25 percent less food than the others.

After three months, Carey used a technique called microdialysis, which involves placing a tiny probe directly into the fat tissue, allowing her to study the issue in its natural environment. A small sample of fat was also taken from the pigs and brought to the lab for cell size and receptor measurements.

Carey found that the exercised animals on restricted diets had smaller fat cells, fewer adenosine receptors and gave up their fat contents more easily than cells from the other groups, including the full-fed but fit swine. This suggests that eating too much dampens the effects of exercise.

"We hypothesize that the body reacts to the excess levels of epinephrine released during exercise by counter-releasing adenosine to prevent the cells from depleting their fat," Carey explains. "But the signal is so loud, that the fat cells, respond to this extra adenosine by lowering the number of receptors. It's as if you live on a busy street, so you shut the window to block the noise. In our experiment, adenosine levels were higher, but the receptor number in the exercised, restricted-fed pigs dropped from 310 to 180, a 42 percent decrease. The exercised, full-fed pigs saw a decrease of only 14 percent."

Carey hopes her findings will be used by the medical community to learn more about how the human body mobilizes fat.

"Obesity is a major health problem, and factors such as diet and exercise are known to influence its onset," Carey says. "Understanding how these two variables affect obesity at the molecular level will also help us understand why some people cannot break down fat as readily as others."

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