High salt prevents weight gain in mice on a high-fat diet

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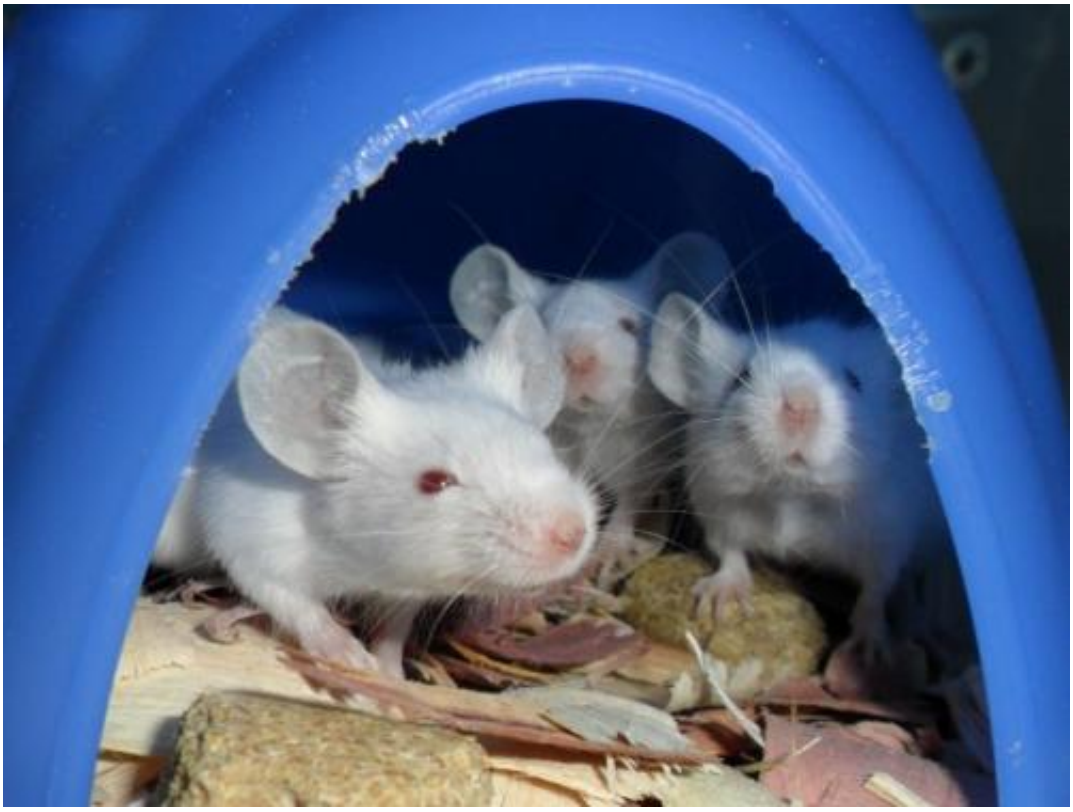

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In a study that seems to defy conventional dietary wisdom, University of Iowa scientists have found that adding high salt to a high-fat diet actually prevents weight gain in mice.

As exciting as this may sound to fast food lovers, the researchers caution

that very high levels of dietary salt are associated with increased risk for cardiovascular disease in humans. Rather than suggest that a high salt diet is suddenly a good thing, the researchers say these findings really point to the profound effect non-caloric dietary nutrients can have on energy balance and weight gain.

"People focus on how much fat or sugar is in the food they eat, but [in our experiments] something that has nothing to do with caloric content - sodium - has an even bigger effect on weight gain," say Justin Grobe, PhD, assistant professor of pharmacology at the UI Carver College of Medicine and co-senior author of the study, which was published in the journal *Scientific Reports* on June 11.

The UI team started the study with the hypothesis that fat and salt, both being tasty to humans, would act together to increase food consumption and promote weight gain. They tested the idea by feeding groups of mice different diets: normal chow or high-fat chow with varying levels of salt (0.25 to 4 percent). To their surprise, the mice on the high-fat diet with the lowest salt gained the most weight, about 15 grams over 16 weeks, while animals on the high-fat, highest salt diet had low weight gain that was similar to the chow-fed mice, about 5 grams.

"We found out that our 'french fry' hypothesis was perfectly wrong," says Grobe, who also is a member of the Fraternal Order of Eagles Diabetes Research Center at the UI and a Fellow of the American Heart Association. "The findings also suggest that public health efforts to continue lowering sodium intake may have unexpected and unintended consequences."

To investigate why the high salt prevented weight gain, the researchers examined four key factors that influence energy balance in animals. On the energy input side, they ruled out changes in feeding behavior - all the mice ate the same amount of calories regardless of the salt content in

their diet. On the energy output side, there was no difference in resting metabolism or physical activity between the mice on different diets. In contrast, varying levels of salt had a significant effect on digestive efficiency - the amount of fat from the diet that is absorbed by the body.

"Our study shows that not all calories are created equal," says Michael Lutter, MD, PhD, co-senior study author and UI associate professor of psychiatry. "Our findings, in conjunction with other studies, are showing that there is a wide range of dietary efficiency, or absorption of calories, in the populations, and that may contribute to resistance or sensitivity to weight gain."

"This suppression of weight gain with increased sodium was due entirely to a reduced efficiency of the digestive tract to extract calories from the food that was consumed," explains Grobe.

It's possible that this finding explains the well-known digestive ill effects of certain fast foods that are high in both fat and salt, he adds.

Through his research on hypertension, Grobe knew that salt levels affect the activity of an enzyme called renin, which is a component in the renin- angiotensin system, a hormone system commonly targeted clinically to treat various cardiovascular diseases. The new study shows that angiotensin mediates the control of digestive efficiency by dietary sodium.

The clinical usefulness of reducing digestive efficiency for treating obesity has been proven by the drug orlistat, which is sold over-the-counter as Alli. The discovery that modulating the renin-angiotensin system also reduces digestive efficiency may lead to the developments of new anti-obesity treatments.

Lutter, who also is an eating disorders specialist with UI Health Care,

notes that another big implication of the findings is that we are just starting to understand complex interactions between nutrients and how they affect calorie absorption, and it is important for scientists investigating the health effects of diet to analyze diets that are more complex than those currently used in animal experiments and more accurately reflect normal eating behavior.

"Most importantly, these findings support continued and nuanced discussions of public policies regarding dietary nutrient recommendations," Grobe adds.

Provided by University of Iowa