Your best diet might depend on your genetics

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The two mice pictured are from different strains and were both fed the Western Diet for 4 months. The mouse on the right was highly susceptible to obesity and metabolic syndrome on a Western Diet (weighs 55 grams), while the other mouse showed resistance to weight gain and metabolic syndrome on the same diet (weighs 35 grams). Credit: Photo courtesy of William Barrington, North Carolina State University.

If you've ever seen a friend have good results from a diet but then not been able to match those results yourself, you may not be surprised by new findings in mice that show that diet response is highly individualized.

"There is an overgeneralization of health benefits or risks tied to certain diets," said William Barrington, Ph.D., a researcher from North Carolina State University who conducted this work in the laboratory of David Threadgill, Ph.D., at Texas A&M University. "Our study showed that the impact of the diet is likely dependent on the genetic composition of the individual eating the diet, meaning that different individuals have different optimal diets."

Barrington will present these new findings at The Allied Genetics Conference, a meeting hosted by the Genetics Society of America.

The new study not only has implications for people seeking the healthiest diet, but also for dietary recommendations such as the ones issued by the U.S. Food and Drug Administration. Since these recommendations are based on average responses of many people, they may not be applicable to many individuals.

"Mice provide a powerful model for studying the effects of diets in different genetic backgrounds because they have similar susceptibilities to obesity and metabolic syndrome, and we can model the genetic diversity that is seen in humans while controlling for environmental factors," said Barrington.

The researchers used four mouse strains to model genetic diversity. All the mice in each strain shared the same genetics, thus representing the genetics of one person. The genetic differences between any two strains were similar to that of two unrelated people.

For six months the mice received food equivalent to today's Western diet, a traditional Japanese diet, a traditional Mediterranean diet, or a high fat, low carb Atkin's-like diet known as ketogenic, while some mice received standard mouse chow for comparison. The mice could eat as much food as they wanted, but the researchers kept tabs on how much was consumed.

The researchers took care to match the test diets closely with what people would eat on the same diet. For example, the Japanese diet used rice as the main carbohydrate and included green tea extract to mimic the effects of this bioactive compound. For the Mediterranean diet, wheat was the main carbohydrate, and red wine extract was included to imitate this key dietary component.

The researchers monitored a variety of health-related diet responses and found that effects of each diet were strongly dependent on the strain of mice. While mice eating the Western diet generally showed negative health effects, including increased obesity, fatty liver disease, and detrimental effects on cholesterol, the severity of those effects varied widely depending on the strain. In fact, one strain of mice appeared largely resistant to any negative health effects from this diet.

The Western diet and the ketogenic diet, which are both high in fat, showed opposite responses for two strains of mice. For one strain, the researchers observed very negative health effects on the Western diet, including increased obesity and fatty liver disease, but saw no negative health effects when this strain ate the high fat, low carb ketogenic diet. On the other hand, a different strain of mice had increased obesity and signs of metabolic syndrome on the ketogenic diet but was much healthier on the Western diet.

"We also found that the causes for obesity were different," said Barrington. "Some mice on specific diets simply ate more calories, and

this caused them to become obese. However, mice on other diets ate less but still became obese."

For all the mouse strains, the ketogenic diet increased calorie burn without any increase in activity level, but some strains of mice ate so much on this diet that they still became obese and experienced negative health effects.

"Given the metabolic and genetic similarity of humans and mice, it is highly likely that the level of diversity of diet response seen in our study will also be observed in humans," said Barrington. "Since there are different optimal diets for different individuals, this underscores the need for precision nutrition, which would identify optimal dietary patterns for each person."

The researchers are now working to identify the genes and biological mechanisms involved in the varying responses to diets. This line of research could eventually lead to a genetic test that identifies who is likely to benefit or experience negative health effects from certain diets.

"We've largely viewed diet the same way for the last 100 years—assuming that there is one optimal diet," said Barrington. "Now that we've identified that this is likely not the case, I think that in the future we will be able to identify the genetic factors involved in the varying responses to diet and use those to predict diet response in humans."

More information: Barrington will present "Pathophysiological responses to dietary patterns differ with genetic backgrounds" during The Allied Genetics Conference from 11:45 a.m. to 12:00 p.m. on Friday, July 15, in Crystal Ballroom G1 at the Orlando World Center Marriott in Orlando, Florida.

Provided by Genetics Society of America