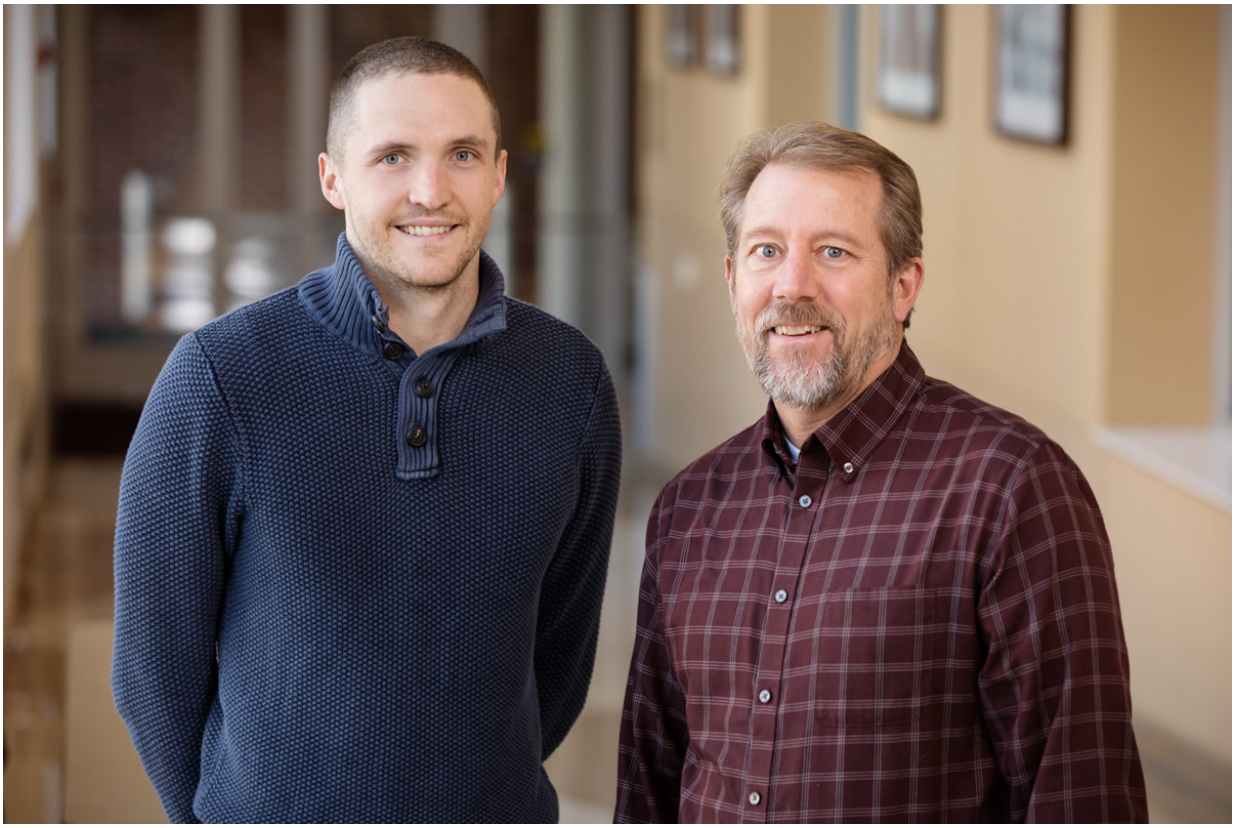
Exercise changes gut microbial composition independent of diet, team reports

December 4 2017, by Diana Yates



Jacob Allen, left, Jeffrey Woods and their colleagues found that exercise alters the microbial composition of the gut in potentially beneficial ways. Credit: L. Brian Stauffer

Two studies - one in mice and the other in human subjects - offer the

first definitive evidence that exercise alone can change the composition of microbes in the gut. The studies were designed to isolate exercise-induced changes from other factors - such as diet or antibiotic use - that might alter the intestinal microbiota.

In the first study, scientists transplanted fecal material from exercised and sedentary mice into the colons of sedentary germ-free mice, which had been raised in a sterile facility and had no microbiota of their own. In the second study, the team tracked changes in the composition of gut microbiota in human participants as they transitioned from a sedentary lifestyle to a more active one - and back again.

"These are the first studies to show that exercise can have an effect on your gut independent of diet or other factors," said Jeffrey Woods, a University of Illinois professor of kinesiology and community health who led the research with former doctoral student Jacob Allen, now a postdoctoral researcher at Nationwide Children's Hospital in Columbus, Ohio. The work with mice was conducted at the U. of I. and with scientists at the Mayo Clinic in Rochester, Minnesota, who develop and maintain the germ-free mice. The work in humans was conducted at Illinois.

In the mouse study, changes in the microbiota of recipient mice mirrored those in the donor mice, with clear differences between those receiving microbes from exercised and sedentary mice.

"That proved to us that the transplant worked," Woods said.

Recipients of the exercised mouse microbiota also had a higher proportion of microbes that produce butyrate, a short-chain fatty acid that promotes healthy intestinal cells, reduces inflammation and generates energy for the host. They also appeared to be more resistant to experimental ulcerative colitis, an inflammatory bowel disease.

"We found that the animals that received the exercised microbiota had an attenuated response to a colitis-inducing chemical," Allen said. "There was a reduction in inflammation and an increase in the regenerative molecules that promote a faster recovery."

In the human study, the team recruited 18 lean and 14 obese sedentary adults, sampled their gut microbiomes, and started them on an exercise program during which they performed supervised cardiovascular exercise for 30-60 minutes three times a week for six weeks. The researchers sampled participants' gut microbiomes again at the end of the exercise program and after another six weeks of sedentary behavior. Participants maintained their usual diets throughout the course of the study.

Fecal concentrations of SCFAs, in particular butyrate, went up in the human gut as a result of exercise. These levels declined again after the participants reverted to a sedentary lifestyle. Genetic tests of the microbiota confirmed that this corresponded to changes in the proportion of microbes that produce butyrate and other SCFAs.

The most dramatic increases were seen in lean participants, who had significantly lower levels of SCFA-producing microbes in their guts to begin with. Obese participants saw only modest increases in the proportion of SCFA-producing microbes. The ratios of different microbes in the gut also differed between lean and obese participants at every stage of the study, the researchers said.

"The bottom line is that there are clear differences in how the microbiome of somebody who is obese versus somebody who is lean responds to exercise," Woods said. "We have more work to do to determine why that is."

More information: Jacob M. Allen et al, Exercise Alters Gut

Microbiota Composition and Function in Lean and Obese Humans, *Medicine & Science in Sports & Exercise* (2017). DOI: 10.1249/MSS.0000000000001495

J. M. Allen et al. Exercise training-induced modification of the gut microbiota persists after microbiota colonization and attenuates the response to chemically-induced colitis in gnotobiotic mice, *Gut Microbes* (2017). DOI: 10.1080/19490976.2017.1372077