Females' and males' muscles differ in sugar and fatty acid handling, study finds

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Females' and males' muscles differ in glucose and fatty acid handling—but regular physical activity quickly triggers similar beneficial metabolic changes in the muscles of both sexes, new research

to be presented at the Annual Meeting of the European Association for the Study of Diabetes (EASD) (Madrid, 9–13 September) has found.

Exercise has a potent effect on skeletal muscle and is the most effective strategy to prevent weight-loss-related muscle loss and type 2 diabetes.

The first author of the study, Dr. Simon Dreher, of the Institute for Clinical Chemistry and Patho biochemistry, University of Tübingen, and Institute for Diabetes Research and Metabolic Diseases, Helmholtz Munich in Tübingen, Germany, says, "Exercise preserves insulin sensitivity in healthy individuals and restores it in those with pre-diabetes or diabetes. However, there are sex-related differences in how skeletal muscle uses glucose and lipids.

"A greater understanding of how the underlying molecular differences between the skeletal muscles of females and males affect their response to exercise could provide valuable insight into how to tailor exercise recommendations to more effectively prevent or delay the progression of type 2 diabetes. It could also help with the prevention of obesity."

To learn more, Dr. Dreher and colleagues analyzed the molecular differences in muscle biopsies from nine males and 16 females. All were healthy, with an average age of 30 years, living with overweight or obesity and did not take part in regular sporting activities.

The participants performed one hour of moderate to intense endurance exercise (30 min cycling on an ergometer, 30 min walking on a treadmill) under supervision, three times per week for eight weeks in total. Biopsies were collected in a resting state before the intervention started (baseline), after the first exercise session (acute exercise response) and after the last session at the end of the eight weeks.

Epigenomics (this looks for chemical changes that affect whether genes

are switched on or off), transcriptomics (study of RNA molecules) and proteomics (study of the structure and function of proteins) were used in the multi-omics analysis of muscle cells and fibers from the biopsies.

At baseline, there were sex-related differences in levels of the RNA strands, or transcripts, in skeletal muscle associated with glucose homeostasis (control of blood sugar levels) and insulin signaling (the biochemical pathway through which insulin moves sugar out of the blood and into the body's cells).

There were also differences in the proteins the sexes' muscles were using to turn food into energy. There was a higher number of glycolysis-related (involved in the processing of glucose) and other fast-twitch fiber-type proteins in males, while females showed a higher abundance of proteins regulating fatty acid handling.

"This, in line with the RNA results, suggest that the male muscle has a higher capacity to exercise on glucose while females use more fatty acids," says Dr. Dreher. "This difference in substrate use might be of relevance during exercise and also influence the development of type 2 diabetes."

The response to the first exercise session differed substantially between the untrained females and males, with the males' muscles showing much more evidence of cellular stress, suggesting the males' muscles found it more difficult to adapt to exercise than the females' muscles.

After eight weeks of exercise training, the differences between females' and males' skeletal muscle had lessened, and, in both sexes, levels of proteins involved in turning food into energy had increased.

"This is important because the increased capacity after exercise to use glucose and lipids for energy production is generally regarded as key to

prevent type 2 diabetes," says study leader Professor Cora Weigert, also of the Institute for Clinical Chemistry and Pathobiochemistry, University of Tübingen, and Institute for Diabetes Research and Metabolic Diseases, Helmholtz Munich in Tübingen, Germany.

"While initial response of skeletal muscles to exercise differs between females and males, repeated exercise appears to cancel out these differences and trigger beneficial metabolic changes in both sexes."

Provided by Diabetologia

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