'Weight training' muscles reduce fat, improve metabolism in mice

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Researchers from the Boston University School of Medicine (BUSM) have demonstrated that in mice, the use of barbells may be as important to losing weight and improving health as the use of running shoes. The discovery builds upon the fact that skeletal muscle consists of two types of fibers. Endurance training such as running increases the amount of type I muscle fibers, while resistance training such as weightlifting increases type II muscle fibers.

Using a mouse genetic model, BUSM researchers demonstrated that an increase in type II muscle mass can reduce body fat which in turn reduces overall body mass and improves metabolic parameters such as insulin resistance. These studies indicate that weight bearing exercise, in addition to endurance training, may benefit overweight people. The study appears in the February 6th issue of *Cell Metabolism*.

The researchers genetically engineered a mouse, called the MyoMouse, to grow type II fibers by activating a muscle growth-regulating gene. The gene, called Akt1, was engineered in such a way that it could be turned on and off at will by researchers. Even without exercise, activating the gene made the MyoMouse physically stronger. When the gene was de-activated, the mouse returned to its original strength. While stronger and faster than a regular mouse, the MyoMouse did not run with as much endurance on a treadmill, a finding that is consistent with the growth of type II rather than type I muscle. These findings demonstrate that the mouse was genetically programmed to have the characteristics of a lean and powerful sprinter rather than those of a gaunt marathon runner.

In the study, the Akt1 gene was turned off and the MyoMice were fed a high fat/high sugar diet with a similar caloric composition as a meal from a fast food restaurant. Over an eight-week period, the mice became obese and insulin resistant and developed fatty acid deposits in their liver, a condition referred to as hepatic steatosis or fatty liver disease.

The researchers then activated the Akt1 gene in the animals which led to the growth of type II muscle fibers. “Remarkably, type II muscle growth was associated with an overall reduction in body mass, due to a large decrease in fat mass. In addition, blood tests showed that these mice became metabolically normal and their fatty liver disease rapidly resolved,” said senior author Kenneth Walsh, PhD, a professor of medicine and head of Molecular Cardiology at the Whitaker Cardiovascular Institute at BUSM.

The beneficial changes occurred despite the fact that the mice continued to eat the same high-calorie diet and did not display any increase in physical activity. “This work shows that type II muscle just doesn’t allow you to pick up heavy objects, it is also important in controlling whole body metabolism,” added Walsh.

Further analysis found that the mice burned fat because of changes in the physiology and gene expression of their fat and liver cells. “Thus, it appears that the increase in type II muscle fiber orchestrates changes in the body through its ability to communicate with these other tissues,” he said.

These findings indicate that type II muscle has a previously unappreciated role in regulating whole body metabolism through its ability to alter the metabolic properties of remote tissues. These data also suggest that strength training, in addition to the widely-prescribed therapy of endurance training, may be of particular benefit to overweight individuals

Finally, these findings may be relevant for understanding aspects of the aging process. “Beyond the age of thirty, humans lose approximately 6 lbs of muscle mass per decade. Surprisingly, aging individuals predominantly lose type II muscle. Thus a 50 year old may be relatively good at playing tennis or jogging because type I muscle is preserved, but a measurement of grip strength or core body strength could show appreciable declines,” explained Walsh. Therefore, this new study suggests that the loss of type II muscle contributes to the development of obesity and diabetes as we age.

The BUSM researchers suspect that the beneficial effects of muscle growth seen in the MyoMouse are mediated through the production and secretion of a variety of signaling factors. Walsh and his colleagues are currently identifying the novel proteins in muscle that communicate with other tissues. These new proteins, referred to as “myokines” from the Greek words “muscle” and “motion,” may represent new targets for therapies that mimic the benefits of weight training for the treatment of obesity and diabetes as well as muscle wasting disorders.

Source: Boston University