Medical Xpress

Can you be born a couch potato?

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The key to good health is to be physically active. The key to being active is… to be born that way? The well-documented importance of exercise in maintaining fitness has created the idea that individuals can manage their health by increasing their activity. But what if the inclination to engage in physical activity is itself significantly affected by factors that are predetermined? Two new studies suggest that the inclination to exercise may be strongly affected by genetics.

Controlled experiments into the effects of genetics on human activity have yet to be attempted, but recent studies on mice – the standard test species for mammalian genetics – have found genetic influences.

In a paper recently published in the journal *Physiological Genomics,* a team of researchers led by University of North Carolina at Charlotte kinesiologist J. Timothy Lightfoot announced that they had found six specific chromosomal locations that significantly correlate to the inheritance of a trait of high physical activity in mice, indicating that at least six genetic locations were affecting activity. Now, in a study forthcoming in *The Journal of Heredity*, the same team has identified 17 other genetic locations that also appear to control the level of physical activity in mice through interaction with each other, a genetic effect known as epistasis. Together, the located genes account for approximately 84% of the behavioral differences between mice that exhibit low activity levels and mice that show high activity traits.

"Can you be born a couch potato? In exercise physiology, we didn't used to think so, but now I would say most definitely you can," said Lightfoot.

The question of whether genetic influences can significantly affect activity in humans has never been rigorously studied, Lightfoot notes, but experiments with mice are indicating that the effect can be strong.

"The problem with the human literature in activity is that, up until recently, research has ignored the possibility that activity is regulated by biological as much as by environmental factors. What's interesting is that there is a disconnect between the animal and the human literature in this – researchers haven't been paying attention to the animal studies which, for example, have shown that that hormones affect activity."

Lightfoot's interest in the issue drew him to work with strains of mice that had markedly different behaviors when given an exercise wheel. A "high-active" strain scored notably higher than other strains in speed, duration and distance achieved in running than other strains, including one that was labeled as "aggressively sedentary" because of its consistent avoidance of activity.

At first, Lightfoot suspected that the difference was due to genetic factors affecting the way energy is used by muscle tissue because early genetic studies of the strains indicated that variation was present in genes known to affect metabolism. However, studies the team conducted on muscle tissue in the different mice failed to show a genetic effect that could cause a difference in muscle performance.

"We have done some gene chips on muscle tissue and we don't see any differential expression between high-active and low-active animals in peripheral (muscle) tissue," Lightfoot said. "So the suggestion that by over-expressing a glucose transporter we can increase activity doesn't seem to be the explanatory factor."

Subsequent studies have led the team to suspect that genetic differences are having a profound affect on mouse activity levels by causing significant differences in their brains.

"More and more what we are seeing is differences in brain chemistry. We are really convinced now that the difference is in the brain," Lightfoot said. "There is a drive to be more active."

The current studies interbred active and inactive strains of mice to re-sort the genes. The researchers tested the second generation (f2) of offspring for activity using three measurements -- speed, endurance and distance – and found a range of significant differences among the new hybrid mice in their overall activity levels. The team then performed genetic tests on the mice and found significant correlations between differences in their genomes and the behavioral variations.

The team identified six locations on the mouse chromosome where differences had a strong relationship to activity, indicating at least six genes that individually can affect activity. A second genetic study found seventeen other genetic locations that were also having an effect on activity levels by interacting with each other.

While differences in activity could not be exclusively connected to genetics, a surprisingly large amount of the activity difference in the hybrids – about half – had a strong relationship to the specific genetic variations identified.

"We don't know yet what the genes involved in activity are doing, but there is some strong suggestion that many of them may be involved in regulating dopamine," Lightfoot noted. "In one sense it is very similar to a model for genetic influences on ADD."

Source: University of North Carolina at Charlotte