SCIENCE & MEDICINE

Some might be born to run

By Christie Aschwanden

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For decades, fitness gurus have admonished sofa spuds to adopt a can-do attitude toward exercise, as if the only thing keeping them from the gym or walking path was the right attitude.

Yet a growing body of evidence suggests that it's not merely motivation but also genetics that separate slouches from fitness fanatics, and at least some of these genes appear to act on the brain's pleasure and reward center.

Though the science doesn't imply that people disinclined to exercise can't get moving, it helps explain why some people find it more difficult than others to "just do it."

"We all know people who can't sit still and we all know people who can't get off the couch," says J. Timothy Lightfoot, an exercise physiologist at the University of North Carolina in Charlotte.

Studies of twins suggest that some of the differences between these types of people come down to genetics. A 2006 Swedish investigation looked at leisure-time physical activity in 5,334 identical and 8,028 fraternal twins. The findings revealed that the exercise habits of identical twins were twice as closely matched as those of fraternal twins.

Fraternal twins share half their genes on average, whereas identical twins are genetic duplicates, so the finding implies that genes account for much of the variability in physical activity levels between people.

Likewise, a 2006 study that pooled data on exercise participation in more than 37,000 twin pairs from seven European countries calculated the genetic influence on physical activity at somewhere between 48% and 71%.

And these are not isolated findings.

“We now have more than 20 twin studies showing almost unanimously that [identical] twins are more alike in their physical activity than [fraternal] twins,” says geneticist Claude Bouchard, executive director of the Pennington Biomedical Research Center in Baton Rouge, La. The studies make a compelling case that the inclination to exercise runs in families, he says.

Studying mice

In an effort to find the genes involved, physiologist Theodore Garland at UC Riverside turned to rodents. He placed exercise wheels in the cages of ordinary mice and measured how often they scurried around in the wheels.

“This was voluntary exercise,” Garland says. “It’s sort of like how some people jog and others don’t.”

Researchers then selected the mice who ran the most and bred them with other so-called “high-runners” and repeated the experiment for more than 50 generations.

The result was a strain of high-runner mice that run as many as eight hours per night.

Garland’s next step was to find out what caused the mice to want to run. He found clues in the brain.

In a study published in 2003, his group showed that high-runner mice and regular mice respond differently to stimulants such as cocaine and Ritalin. Regular mice would run more when plied with the stimulants. “But we’ve never found a drug that will increase running in high-running mice,” he says. Whatever those drugs do in the brain seemed to be already turned on in the high-runner mice.

Because cocaine and Ritalin alter levels of the brain chemical dopamine, a neurotransmitter involved in pleasure and reward, the drugs’ different effects on the two breeds suggest high-runner and regular mice may process dopamine differently in the brain -- and that may dictate how much pleasure they get out of running.

Other studies have also linked physical activity to dopamine.

For instance, a 1998 study showed that mice deficient in a receptor involved in processing dopamine, the D2 receptor, are less active than those with normal D2 receptor levels.

More recently, Lightfoot and his colleague Amy Knab found that two other dopamine-related genes were less active in their high-runner mice.

Says Knab, who is an exercise physiologist at Appalachian State University, “There’s something inherently different in the dopamine systems of the high-runners versus low-runners.”

Human studies have also linked exercise frequency to dopamine. Bouchard’s research team studied physical activity levels in a sample of 721 volunteers from 161 families in Quebec, Canada. They found that variations in the dopamine D2 receptor gene correlated to physical activity levels in women, but not men.

It’s a start

Bouchard says the study is an intriguing start -- but he speculates that there are many more genes that influence exercise inclination.

Environment still plays a major role in how much someone exercises, though. “You can’t blame being lazy on your genes,” Knab says.

In fact, a twins study published last year suggests that environment trumps genetics when it comes to the kind of exercise needed for good health.

When University of Washington exercise physiologist Glen Duncan and his colleagues examined data from the university’s twin registry they found that genetics did predict the propensity to exercise up to 60 minutes per week.

But at 150 minutes or more -- the amount of exercise that public health officials recommend -- “the genetic component went away and the environment was the bigger factor,” Duncan says. For example, if people walk into a building and see a set of stairs first thing, they will probably take them. But if there’s an escalator front and center, they’ll take that instead, he says.

Researchers are now trying to tease out the ways that genes and the environment combine to turn one person into a marathon runner and another into a couch potato. By doing so, they may discover more effective ways to encourage exercise among those not naturally inclined.

“It’s really hard to change people’s physical activity levels,” physiologist Joey Eisenmann at Michigan State University says.

“There are a lot of people working on interventions to increase physical activity, and for the most part they haven’t been shown to be highly effective. As we learn more about genetic factors, that may shed light on why these programs don’t work as well as we’d like.”

Some of this research may eventually lead to more individualized approaches to fitness.

Or -- failing that -- researchers may even learn to enhance exercise’s gratifying effects with drugs.

“Some day,” Garland says, “we could be giving people pills to make it more pleasurable to run.”

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