Another reason to break a sweat

In addition to boosting your brainpower, exercise may fend off and even alleviate cognitive ills, including Alzheimer's disease, research suggests.

BY BETH AZAR

It's well-known that Americans' sedentary lifestyle is largely to blame for our obesity epidemic. What's less known is that inactivity may also be a culprit in the rise in some mental illnesses, including depression, ADHD, Alzheimer's disease and even fetal alcohol syndrome.

Although no one's proven a direct link between inactivity and a national decline in mental health, evidence is mounting to show that cardiovascular exercise helps prevent — and may even reverse — cognitive deficits by improving overall brain health, stimulating the birth of new neurons and encouraging the growth of new neural connections.

The evidence for exercise's cognitive benefits has been mounting for decades, and, when taken as a whole, the research strongly supports the idea that cardiovascular exercise significantly improves cognitive health as well as learning and memory.

"The results are pretty universal," says University of Illinois at Urbana-Champaign psychologist Art Kramer, PhD, who conducted a comprehensive literature review on the subject, published in *Trends in Cognitive Sciences* (Vol. 11, No. 8).

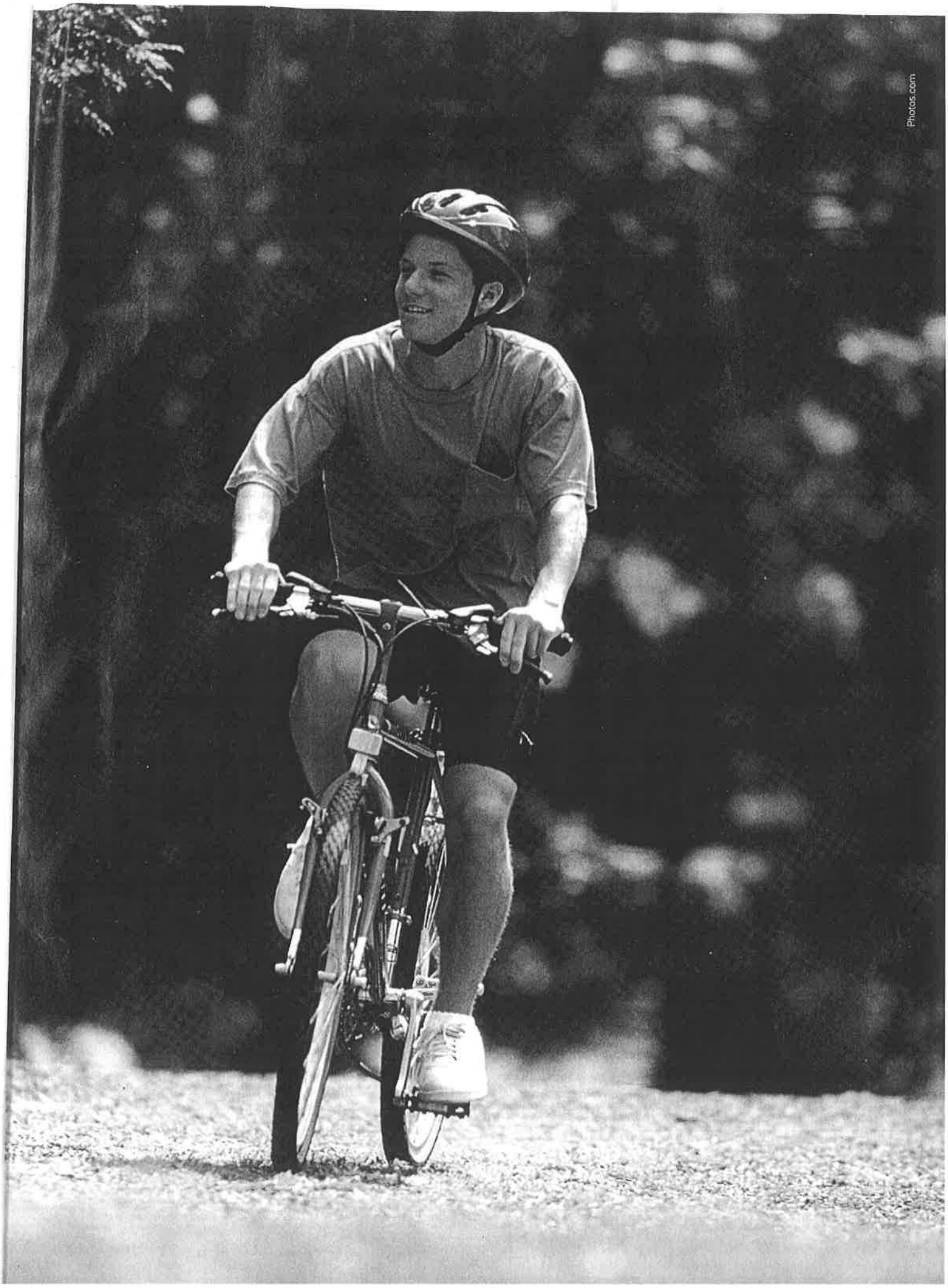
But what scientists don't know is how much exercise people need to see its full effect. "What we do know is that there's no free lunch. If you give up exercise, you give up its benefits," Kramer says.

Proving a causal connection

Some of the most recent evidence for exercise's cognitive-boosting effects comes from a study in the December 2009 *Proceedings of the National Academy of Sciences* (Vol. 106, No. 49). When the researchers looked at the records of 1.2 million 18-year-old Swedish men who enlisted for mandatory military service from 1968 to 1994, they found that the men with better cardiovascular fitness had higher scores on measures of general intelligence, logic, verbal ability and visuospatial ability.

"This study is interesting because it's so huge, its statistics are very powerful," says Kramer.

But, he says, because it's observational, it doesn't prove that exercise leads to improved cognition. To show a


Photos.com

causal link, Kramer and other researchers have conducted randomized controlled trials to test exercise's effect on cognition. In a 2004 study, for example, Kramer and his colleagues randomly assigned a group of 29 previously sedentary older adults either to an aerobic exercise program — walking three times a week for 45 minutes — or to a stretching and toning program for up to six months. They found that the exercise group performed better than the stretching group on several measures of executive function, which includes planning, scheduling, working memory and multitasking. The aerobic exercisers also had increased brain activity in areas of the cortex used to perform the executive function tasks.

Inspired by Kramer's work, cognitive psychologist Laura Baker, PhD, designed a randomized controlled trial to examine whether aerobic exercise could help delay the onset of Alzheimer's disease. She and her colleagues from the University of Washington School of Medicine and Veterans Affairs Puget Sound Health Care System randomly placed 33 people diagnosed with mild cognitive impairment into one of two groups. Four days a week, for six months, 23 participants exercised aerobically for up to an hour. The remaining participants spent the same amount of time working on stretching and balance. The study, published in January in the *Archives of Neurology* (Vol. 67, No. 1), found that the aerobic exercisers showed significant improvements on tests of executive function. In contrast, the stretching group continued to decline in these areas.

"We conducted many cognitive tests to make sure what we were seeing was real," says Baker. "And we saw significant improvements on all executive function tasks, but not on tests of short-term memory."

That may be because subtle exercise-related benefits on memory performance may be overshadowed when people still have a number of effective strategies — such as rehearsal, visualization and relating information to personal experience — that they can use to accomplish short-term memory tasks. Or the finding may show that exercise doesn't delay the deterioration of short-term memory. Baker has started a larger study to explore those possibilities and pinpoint how exercise improves executive function.

The mental health link

Researchers don't yet know the biological mechanisms through which exercise improves brain health, but animal research is providing clues. Studies in rats, mice and dogs show that aerobic exercise improves brain function by growing new capillaries and increasing blood flow, increasing the production of proteins that improve neuron function and stimulating the growth of new nerve cells. Even the mature neurons of exercising animals grow, reaching more dendrites out to neighboring neurons. This is especially common in areas of the brain involved in learning and memory, such as the hippocampus, says University of Victoria psychologist Brian Christie, PhD.

"I like to think of [dendrites] like telephone lines: The more there are, the more people you can talk to at once," says Christie, whose work in mice showed the link between exercise and dendrites. "This is how I think exercise is increasing the brain's flexibility."

Increased cognitive flexibility may also help alleviate mental health problems, including depression and ADHD that can be caused or aggravated by inflexible thinking as when people with depression ruminate on unpleasant thoughts. Several clinical studies — including a 2007 randomized controlled trial by Duke University psychologist James Blumenthal, PhD — show that exercise can work as well as antidepressants. Also, some small studies hint at its effectiveness in improving ADHD, although no large-scale studies have been done to prove the link.

Such research led Christie to think about whether exercise could have an impact on a condition as severe and intractable as fetal alcohol spectrum disorder. His "aha" moment came when he heard another researcher say the brains of children with the disorder are highly rigid, with fewer cells in the hippocampus, fewer synapses and less synaptic plasticity — the ability of the connections between neurons to change in strength, which is essential for learning and memory.

"It's completely the opposite of what we see exercise do in animals," he recalls.

He found a rat model of fetal alcohol spectrum disorder: Like humans with the condition, the animals were exposed to alcohol *in utero* and grew to be anxious adults that learned more slowly and did poorly on many spatial and emotional tasks. But after just 12 days on an exercise program, the rats with the disorder behaved no differently than the rats without it. What's more, their hippocampi showed increased synaptic plasticity and new neuronal growth.

Further preliminary research indicates that exercise might prevent the fetal alcohol disorder. Gerd Kepperman, PhD, of the Center for Regenerative Therapies in Dresden, Germany, has found that he can prevent the effects of *in-utero* alcohol exposure on mouse pups altogether if he gets the pregnant mothers to exercise. Of course, since humans are more complex than mice, it's unlikely that exercise will garner such dramatic results, says Christie.

Still, there's plenty of evidence to suggest that Americans need to get moving if we want to improve our mental as well as our physical health.

"At the worst, exercise is going to give you a healthier body," says Christie. "At the best, it will help some people gain a cognitive capacity they don't possess right now. But, bottom line, everyone will benefit in the end. I don't think there's a group of people that shouldn't engage in exercise, although some may require medical supervision." ■

Beth Azar is a writer in Portland, Ore.