Telegraph.co.uk

Boost your brain – use your brawn

BST 04/04/2007

'If you're sporty, you must be thick' is a misguided cliché. In fact, a new study says exercise actually increases memory and learning potential. Victoria Lambert reports

Were you one of those forever leaping about on the tennis court at school or were you more likely to be found huddled around the Bunsen burner? Sporty or swotty, the two tribes have, by tradition, rarely crossed - save for the odd all rounder, who managed to be captain of games while studying advanced maths. Now, new research from America is confounding the old stereotypes, with the finding that exercise actually makes your brain bigger and more capable of learning.

'We have to keep people active through mid-life - maybe these new findings will provide the right carrot for them,' says Prof Bruce Lynn from University College London

The study, carried out at the Columbia University Medical Centre in New York, has shown that working out the muscles could simultaneously be pumping up the brain - and specifically the memory.

Exercise appears to directly affect a region of the hippocampus, the area of the brain concerned with memory and learning, called the dentate gyrus, one of the few areas of the brain where neurogenesis - the creation of nerve cells - takes place. Building up the number of nerve cells (neurons) and the connections between them in the dentate gyrus is vital to the prevention of memory decline that typically begins at around the age of 30. So does this mean that aerobic exercise can help anyone increase their learning potential?

Cell production is a complex affair relying on a ready supply of proteins and hormones, particularly a hormone called Insulin-like Growth Factor 1 (IGF-1). IGF-1 is known to be crucial in child growth and the development of every cell in the body. It is released into the bloodstream every time you contract and relax a muscle and so levels rise when you exercise.

When IGF-1 reaches the brain, it acts on the cells that release neurotransmitters, the chemicals responsible for communication. It triggers an increase in production of brain-derived neurotrophic factor or BDNF, which promotes the growth of new nerve cells and which Harvard psychiatrist, John Ratey, has nicknamed "Miracle-Gro for the brain".

As new brain cells are created, they form pathways and links, as we learn new facts and skills. The greater level of BDNF you have, the more new nerve cells you can produce and the greater the number of building blocks available to you to extend your learning capacity. But if levels fall, it can work in reverse. Those born with a faulty variant of the gene responsible for the production of BDNF have trouble with recall and creating new memories.

Using an MRI scanner, the Columbia researchers led by Professor Scott Small examined a living brain before and after exercise and, for the first time, were able to see neurogenesis effectively in action.

Those most likely to benefit from the finding are victims of degenerative brain disorders such as Alzheimer's, and the next step will be to use this information to create an exercise regime specifically tailored to preventing age-related memory loss.

Professor Bruce Lynn, from University College London, welcomes the new findings. He recalls similar findings being presented in the 1960s - and then ignored by the scientific community. Even five years ago, he says, there were only half a dozen papers on the topic; yet now it has become a very active area for research, as it has become abundantly clear that those who remain physically active stay cognitively fit, too.

"The big question however," says Prof Lynn, "is what is the link? It is not obvious why exercise has this effect on the brain. Growth factors are important but blood flow to the brain is not relevant. Some people suggest increased oxygen is crucial but our blood is always saturated with oxygen unless we're in the Himalayas - or, ironically, exercising.

"What type of exercise you choose seems to matter: aerobics works, but you don't get the same results from strength training. However, when you are strength training - using weights - you see big increases in the production of IGF-1."

At the University of Birmingham, Professor Asker Jeukendrup, a specialist in exercise metabolism, confirms there is a lot of evidence that physical activity helps brain development. He thinks there is some truth to the theory that suggests improving blood supply and therefore fuel to the brain is important.

"You don't need to do much to get an effect," he says. "Studies have already shown that just 20 minutes walking - not even particularly briskly - will reduce degeneration of the brain and improve learning ability. Yet many people are still below that threshold. And, of course, other studies show that the more you do, the better it gets."

He believes it is important this message gets across to the older generation. "If you can keep the elderly active, their quality of life improves so much."

Prof Lynn agrees that promoting exercise for the over-sixties is important. "It just has so many benefits, particularly for the mind. A lot of effort is put into preventing falls - but they are not just due to weakening muscles but also problems with balance, which occur in the brain."

What he finds particularly encouraging about the latest study is that it confirms it is never too late to revitalise your mind.

"This is a great thing to promote. After all, we all want a beautiful body, but staying in sound mind as we age is even better. Improving mental health is very important to the quality of life in an ageing population."

While he is also confident that the message about exercise is getting through to children via schools programmes, and increasingly to the elderly, he worries about the 20-60 age group.

"We have to keep people active through mid-life - maybe these new findings will provide the right carrot for them."

Another study due to be published later this year by Charles Hillman, a hockey-playing neuroscientist at the University of Illinois, and previewed in the current edition of Newsweek magazine, will show that in a group of 259 students, allowing for socio-economic factors, those who had the fittest bodies also had the fittest minds, measured via a maths and reading test.

When Prof Lynn considers prospective students for his university course, grades being equal, he will favour those who play sport to a high level.

"It's true that you can't study as hard as you or I might wish if you are an elite athlete, but you are used to performing at that level. The potential and the competitive spirit are there.

"At UCL, we have a bright bunch of students and a high proportion of them are physically active.

"This image - that if you are sporty, you must be thick - is more about wanting to put people down. The polymath is not that unusual. Think of the Nobel-prize winner Prof Vivian Hill who was also an Olympic athlete."

A word of warning: if your training programme includes a congratulatory drink after the work-out, then you'll undo all your good work, according to Prof Lynn, as "alcohol depresses neurogenesis."

So by all means take up golf - just steer clear of the 19th hole.

The Alzheimer's connection

Matching names to faces is one of the first skills to go as our memory starts to deteriorate. The area of the brain where this happens is the dentate gyrus - the area that the Columbia university researchers noticed was seeing cell regeneration after exercise. A separate study at Illinois University has seen improvement in the frontal lobes after exercise: this area is connected to what is known as the Executive Function - which covers decision-making, forward planning and multi-tasking.

It's no wonder Professor Simon Lovestone, a specialist in old age psychiatry at King's College London, finds the evidence very interesting and with definite implications for the study of Alzheimer's. 'An increasing amount of evidence shows that activity is beneficial - both in people and in mice - although we're not sure of the mechanism,' he says.

Scientists have already discovered that ageing mice - which were made to exercise more by running on wheels - fared better in memory tests. Carl Cotman, a neuroscientist at the University of California, found that those mice which are susceptible to a similar disease to Alzheimer's, characterised by levels of plaque in the brain, had lower levels of plaque when he put them to the treadmill. He concluded that it might inhibit the development of the plaque or stimulate cells to clear it away.

Prof Lovestone explains this is significant. 'People who routinely exercise are quite different to those who don't in terms of diet, affluence, class and general lifestyle. Yet mice don't have class or affluence differences - so while the jury is out on how this works, exercise clearly has a direct effect on the brain.'