# Runner's high motivated the evolution of exercise

22 March 2012

In the last century something unexpected happened: humans became sedentary. We traded in our active lifestyles for a more immobile existence. But these were not the conditions under which we evolved. David Raichlen from the University of Arizona explains that our hunter-gatherer predecessors were long-distance endurance athletes.

'Aerobic activity has played a role in the evolution of lots of different systems in the human body, which may explain why aerobic exercise seems to be so good for us', says Raichlen. However, he points out that testing the hypothesis that we evolved for high-endurance performance is problematic, because most other mammalian endurance athletes are quadrupedal. 'So we got interested in the brain as a way to look at whether evolution generated exercise behaviours in humans through motivation pathways', says Raichlen.

Explaining that most human athletes experience the infamous 'runner's high' after exertion, which is caused by endocanabinoid signalling in the so-called 'reward centres' of the brain, Raichlen adds little was known about the role of endocanabinoids in the other aerobically active mammals. So, he teamed up with Gregory Gerdeman and other colleagues to find out how exercise influences the endocanabinoid levels of two mammalian natural athletes - humans and dogs - and a low activity species - ferrets. The team publish their discovery that animals that evolved for endurance exercise benefit from endocanabinoids while animals that did not don't experience the pleasures, leading them to propose that natural selection used the endocanabinoid system to motivate endurance exercise in humans. The team publishes their discovery in The *Journal of Experimental Biology*.

Recruiting recreational runners and pet dogs from the local community, Raichlen and Adam Foster trained the participants to run and walk on a treadmill and collected blood samples from the participants before and after the exercise. Unfortunately, the ferrets were less cooperative, so the team collected the ferrets' blood samples after exercise and during rest.

Next, Andrea Giuffrida and Alexandre Seillier analysed the endocanabinoid levels in the blood samples and found that the concentration of one endocanabinoid - anandamide - rocketed in the blood of the dogs and humans after a brisk run. And when the team tested the human runners' state of mind, they found that they athletes were much happier after the exercise. However, when the team analysed the ferrets' blood samples, the animal's anandamide levels did not increase during exercise. They did not produce endocanabinoids in response to high-intensity exercise.

Having suggested that natural selection used the endocanabinoid system to motivate endurance exercise in humans and other animals that walk and run over long distances, Raichlen adds 'These results suggest that natural selection may have been motivating higher rather than low-intensity activities in groups of mammals that evolved to engage in these types of aerobic activities'.

Having found that exercising mammals release pleasurable endocanabinoids in response to exercise, could these brain chemicals be the magic bullet that solves the obesity crisis? Sadly not, says Raichlen, who explains that couch potatoes are not about to leap suddenly out of their comfy chairs and experience the pleasurable effects of exercise, because they probably cannot produce enough endocanabinoids. He says, 'Inactive people may not be fit enough to hit the exercise intensity that leads to this sort of rewarding sensation.' However, he is optimistic that inactive individuals can be helped to build up their exercise tolerance until they cross the threshold where they become motivated to exercise by endocanabinoids. Raichlen also suggests that exercise could be a cheap solution to

many medical conditions, improving our mental state through the endocanabinoids and our cardiovascular and pulmonary condition through good old-fashioned exertion.

**More information:** Raichlen, D. A., Foster, A. D., Gerdeman, G. L., Seillier, A. and Giuffrida, A. (2012). Wired to run: exercise-induced endocannabinoid signaling in humans and cursorial mammals with implications for the 'runner's high'. J. Exp. Biol. 215, 1331-1336. jeb.biologists.org/content/215/8/1331.abstract

Provided by The Company of Biologists