The myth of runner's high revisited with brain imaging

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Throughout the world, amateurs, experts and the media agree that prolonged jogging raises people's spirits. And many believe that the body's own opioids, so called endorphins, are the cause of this. But in fact this has never been proved until now.

Researchers at the Technische Universität München and the University of Bonn succeeded to demonstrate the existence of an 'endorphin driven runner's high'. In an imaging study they were able to show, for the first time, increased release of endorphins in certain areas of the athletes' brains during a two-hour jogging session. Their results are also relevant for patients suffering from chronic pain, because the body's own opiates are produced in areas of the brain which are involved in the suppression of pain.

The researchers, some of whom are also members of the German Research Network of Neuropathic Pain (Deutscher Forschungsverbund Neuropathischer Schmerz, DFNS), which is also funded by the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF), thereby show that jogging not only makes you high, but can also relieve pain. The results of the study have now been published in the scientific journal *Cerebral Cortex*.

Endurance sports have long been seen as reducing stress, relieving anxiety, enhancing mood and decreasing the perception of pain. The high that accompanies jogging even led to the creation of its own term, 'runner's high'. Yet the cause of these positive effects on the senses was

not clear until now. The most popular theory was and still is the 'Endorphin Hypothesis', which claimed that there was increased production of the body's own opioids in the brain. However, since until now direct proof of this theory could not be provided; for technical reasons, it was a constant source of controversial discussions in scientific circles. The result was that the myth of 'runner's high through endorphins' lived on.

Scientists from the fields of Nuclear Medicine, Neurology and Anaesthesia at the Technische Universität München (TUM) and the University of Bonn have now subjected the endorphin theory to closer scrutiny. Ten athletes were scanned before and after a two-hour long-distance run using an imaging technique called positron emission tomography (PET). For this they used the radioactive substance [18F]diprenorphine ([18F]FDPN), which binds to the opiate receptors in the brain and hence competes with endorphins. 'The more endorphins are produced in the athlete's brain, the more opiate receptors are blocked,' says Professor Henning Boecker, who coordinated the research at TUM and who is now in charge of the 'Functional Neuroimaging Group' at the Dept. of Radiology, University Hospital Bonn.

And further: 'Respectively the opioid receptor binding of the [18F]FDPN decreases, since there is a direct competition between endorphins in the brain and the injected ligand'. By comparing the images before and after two hours of long distance running the study could demonstrate a significantly decreased binding of the [18F]FDPN-ligand. This is a strong argument in favour of an increased production of the body's own opioids while doing long-distance running. 'We could validate for the first time an endorphin driven runner's high and identify the affected brain areas', states Boecker. 'It's interesting to see that the affected brain areas were preferentially located in prefrontal and limbic brain regions which are known to play a key role in emotional processing. Moreover, we observed a significant increase of the euphoria

and happiness ratings compared to the ratings before the running exercise.'

Professor Thomas Tölle, who for several years has been head of a research group called ‘Functional Imaging of Pain’ at TU Munich, adds: 'Our evaluations show that the more intensively the high is experienced, the lower the binding of [18F]FDPN was in the PET scan. And this means that the ratings of euphoria and happiness correlated directly with the release of the endorphins.' In addition, as a spokesman of the ‘German Association of Neuropathic Pain’, he feels happy for patients suffering from chronic pain. 'The fact that the endorphins are also released in areas of the brain that are at the centre of the suppression of pain was not quite unexpected, but even this proof was missing. Now we hope that these images will also impress our pain patients and will motivate them to take up sports training within their available limits.'

It is well known that endorphins facilitate the body's own pain suppression by influencing the way the body passes on pain and processes it in the nervous system and brain. The increased production of endorphins resulting from long-distance running could also serve as the body’s own pain-killer, a therapeutic option which is not only of interest to the German Association of Neuropathic Pain. 'Now we are very curious about the results of an imaging study using Functional Magnetic Resonance Imaging which we are currently carrying out in Bonn in order to investigate the influence of long-distance running on the processing of pain directly,' Professor Boecker says.

Further research is required so as to investigate the exact effects on depression and states of anxiety but also on possible aspects which may promote addiction. That is why the relation between genetic disposition and opiate receptor distribution in the brain is being currently investigated at TU Munich. 'A scary thought,' Thomas Tölle comments, 'if we ran because our genes wanted us to do so.' The first step towards

researching these connections has now been made.

Source: University of Bonn