

# High-altitude climbing causes subtle loss of brain cells and motor function

October 16 2008

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A study of professional mountain climbers has shown that high-altitude exposure can cause subtle white and grey matter changes to the area of the brain involved in motor activity, according to the October issue of the *European Journal of Neurology*.

Italian researchers took MRI scans of nine world-class mountain climbers, who had been climbing for at least 10 years, before and after expeditions to Mount Everest (8,848 metres) and K2 (8,611 metres) without an oxygen supply. They compared their MRI brain scans with 19 age and sex matched healthy control subjects.

Both the climbers and controls were carefully checked to exclude the presence of any major systemic, psychiatric or neurological illnesses. None of the control group subjects had any history of high-altitude exposure over 3,000 metres.

The results demonstrated that the climbers showed a reduction in both the density and volume of white matter in the left pyramidal tract, near the primary and supplementary motor cortex, when their baseline measurements were compared with the control group.

And when the researchers compared the before and after scans for the climbers, they also found a reduction in the density and volume of grey matter in the left angular gyrus.

"The aim of our study was to measure the quantitative loss of white and

grey matter, using voxel-based morphometry, which takes spatial, unbiased MRI measurements independent of the operator" explains lead author Dr Margherita Di Paola from the Neuroimaging Laboratory at the IRCCS Fondazione Santa Lucia in Rome.

"The scans were then assessed by two experienced observers who were unaware of whether the scans belonged to the climbers or control group."

All the climbers who took part in the study - carried out in collaboration with the National Research Council, Institute of Biomedical Technologies, Milan, and the Ev-K2-CNR Committee – were male.

They ranged from 31 to 52 years, with an average age of just under 38, and were used to climbing to altitudes of at least 4,000 metres several times a year.

The researchers took the first scans eight weeks before the expedition began and the second set eight weeks after they returned.

One climber reached the top of Everest and K2 and two reached the top of one mountain. The remainder reached altitudes of over 7,500 metres and spent at least 15 days over altitudes of 6,500 metres.

A number of neuropsychological tests were also carried out to assess the climber's cognitive abilities, such as memory and motor functions.

"Despite the loss of grey and white matter, the climbers in our study did not suffer any significant neuropsychological changes after the expedition" says Dr Di Paola.

"Some of the subjects did show abnormal scores on the neuropsychological tests, but in these cases there was no significant

difference between the baseline and follow up results. This suggests that there were no significant changes as a result of a single expedition.

"As they had been carefully checked for any pathological conditions that could cause these abnormal scores, we conclude that these test results are most likely to be due to progressive, subtle, brain insults caused by repeated high-altitude exposure."

Overall, the researchers found that the cognitive abilities that were most likely to be affected were the climbers' executive function and memory. Indeed, six of the nine climbers had lower than average scores on the Digit Symbol test, which measures executive functions such as the ability to anticipate outcomes and adapt to changing situations.

Four scored lower than average on the Block Design test, which measures visuo-motor functions, and three out of nine scored lower than average on the Prose Memory test (immediate recall) and on the Rey's Figure test (delayed recall), which measure the verbal and visuo-spatial memory respectively.

"Our results provide evidence that extremely high-altitude climbs with no external oxygen supply may cause subtle changes in brain tissue, even when well acclimatised individuals do not experience any neurological symptoms" concludes Dr Di Paola.

"These changes in white and grey matter appear to be highly specific to regions of the brain involved in motor activity."

Source: Wiley

Citation: High-altitude climbing causes subtle loss of brain cells and motor function (2008,

October 16) retrieved 17 April 2024 from <https://medicalxpress.com/news/2008-10-high-altitude-climbing-subtle-loss-brain.html>

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