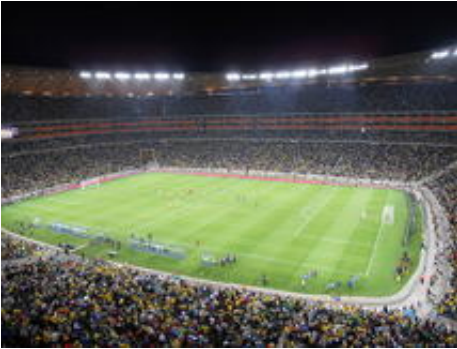


Prolonged altitude training could reduce endurance

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Footballers may wish to limit the amount of training they do at altitude pre-competition.

(PhysOrg.com) -- New research suggests that athletes and footballers may want to limit the time they spend training at altitude to improve their performance.

New research suggests that athletes and footballers may want to limit the time they spend training at altitude to improve their performance.

An Oxford University study has found that people with a rare condition that mimics being at [high altitude](#) for long periods show metabolic differences that actually reduce their endurance and physical performance.

The study is published in the journal *PNAS* and was funded by the British Heart Foundation and the Wellcome Trust.

Athletes from many endurance disciplines use altitude training as part of their yearly training programme. England footballers, as with many of the teams in the World Cup, spent time at altitude acclimatising for the competition in South Africa.

The body reacts to the low levels of oxygen at high altitude, first of all by breathing harder and the

heart pumping more blood, but then through producing more red blood cells and increasing the density of blood vessels in the body's muscles. All of this serves to get more oxygen and fuel to the muscles.

However, an extended stay at altitude can bring a loss of the muscle's ability to use oxygen to carry out work. The number of mitochondria, the oxygen-using powerhouses of the cell, falls with a prolonged stay at high altitude.

'It is the higher capacity to deliver fuel to muscles that athletes are interested in,' explained lead author Dr Federico Formenti of the Department of Physiology, Anatomy and Genetics at the University of Oxford.

'However, it's not clear how long they should train at altitude or how high up they need to be to get the optimal benefits.'

A protein called hypoxia-inducible factor (HIF) is central to the body's response to high altitude. It is stimulated by low levels of oxygen and sets many of these processes in train.

The Oxford University researchers set out to study the metabolism of people with a rare genetic change that leads to continually high levels of HIF, even when levels of oxygen are normal. The increased levels of HIF mean that the condition - called Chuvash polycythemia or CP - is a good model for changes that occur in people who stay at high altitude for long periods.

CP can also offer insight into the fundamental processes where oxygen supply in the body is limited, such as in lung disease, heart disease, vascular disease and cancer.

Only around 20 people in the UK are known to have this mild condition. It is typically only diagnosed when a standard blood test shows

increased numbers of [red blood cells](#) and further tests are done.

Provided by Oxford University

The team compared the performance of five people with CP with five matched controls. In an exercise bike test, in which study participants were asked to keep a constant pedal rate against a steadily increasing resistance, those with CP had to stop exercising earlier. The maximum work rate they achieved for their weight was 30% less than controls. Studies of metabolites present in calf muscles under light exercise also indicated that CP patients experienced greater fatigue. Finally, there were differences in expression of metabolic genes in the CP patients' muscles. This could suggest their metabolism makes less efficient use of the fuel available and may explain their reduced exercise capacity.

'We found that the metabolism of CP patients is different and leads to poorer [physical performance](#) and endurance,' said Dr Formenti.

'Although this is a small study - necessarily so because of there are so few people with the condition - the results are striking. The differences seen in those with Chuvash polycythemia were large, and five patients were more than enough to see this effect,' he said.

'With the help of our volunteers with Chuvash polycythemia, we now understand these fundamental processes better. This understanding should eventually lead to better medical care in the many conditions where oxygen supply in the body is limited, such as heart disease and cancer,' said principal investigator Professor Peter Robbins of the Department of Physiology, Anatomy and Genetics.

'There may be an optimum time for athletes to train at altitude,' Dr Fomenti added. 'More work is needed to find out how long athletes should spend at low oxygen levels to get the most benefit.'

'I don't think it's likely that England footballers will have spent too much time at altitude in the Alps before the World Cup, however,' he added, removing that excuse for England's exit to Germany.

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