

Nature

Published online: 04 August 2004; | doi:10.1038/430604a

ARTICLE SOURCE

nature

The medals and the damage done

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Athletes' punishing schedules push their bodies to the limit. But what happens if they go too far? Jim Giles finds out.

The incessant drive for success can be a dangerous thing for an athlete pushing hard for the Olympics, as Michael Brennan (not his real name) discovered. In 2002, Brennan was a British national rowing champion. The following spring, he rarely finished outside the top three in any race. As the UK Olympic trials loomed, Brennan was feeling confident. But he is not going to this summer's games.

For much of the past 12 months, Brennan's performance has been eroded by constant colds, aching joints and fatigue. What seemed like minor infections refused to go away and extra training made matters worse. When the trials rolled round this April, Brennan still felt that he could qualify. Instead, he finished at the bottom of the heap. "I couldn't believe it," he says.

To an experienced sports doctor, the explanation is obvious: Brennan has 'unexplained underperformance syndrome' (UPS). Perhaps one in ten athletes will get the condition, but only now are hints emerging about the underlying causes. And although sufferers usually recover after a period of rest, it can ruin preparation for major events. "It's all over for an athlete if they get it before a competition," says Greg Whyte, sports science coordinator at the English Institute for Sport in Manchester.

Brennan was officially diagnosed with UPS after a visit to Richard Budgett, director of medical services at the British Olympic Association in London. Budgett, himself a rower and former Olympic gold medallist, sees about 50 athletes a year with the condition, and he says Brennan's story is typical.

Rowers seem particularly susceptible. Athletes in this sport typically train twice a day, five or six days a week. When major competitions approach, they often push their bodies beyond their normal limits for one or two intense weeks, regularly covering 20 kilometres on the water a day. This 'over-reaching' leaves the athletes exhausted in the short term, but in the long term it usually forces their bodies to adapt to intense exertion, improving race performance. Usually. But sometimes the strategy results in UPS — also known as over-training syndrome. "There is a fine line between over-reaching and over-training," says Whyte. "When athletes bounce back from over-reaching they will be stronger, but some don't recover."

Feeling down last summer after a dip in form and problems in a relationship, Brennan responded by upping his training. "I felt I must do more," he says. Instead, continued infections and increasing fatigue forced him to do less. "I was feeling tired all the time," he recalls. "But I kept ignoring it."

“ After being ill I would train harder to make up for it. If I had backed off for a couple of weeks it could all have been sorted out. ”

These symptoms are typical of UPS, along with sleep and mood disturbances, loss of appetite, slow wound healing and gastrointestinal disturbances. If an athlete's performance does not recover after two weeks of relative rest, UPS is usually diagnosed¹.

Hidden menace

Gauging the prevalence of the condition is difficult, as few openly discuss it. "Athletes don't talk about injuries," says Budgett. "They don't want competitors to know." Brennan can be included in that camp, being

happy to tell *Nature* his story as long as his real name wasn't used. Researching the condition is also difficult, as serious athletes aren't willing to give regular blood samples, and it would be unethical to induce full-blown UPS in test subjects.

But, slowly, we are learning more about the syndrome. Over the past decade, a slew of studies has revealed numerous factors in the hormone and immune systems that seem to be linked with the condition, leading to tentative theories about the syndrome's cause.

One explanation was proposed last year by Lucille Lakier Smith, a sports scientist at the Tshwane University of Technology in Pretoria, South Africa². Her inspiration came from studies of victims of serious accidents, such as burns patients. These patients have rather extreme immune reactions to deal with the severe damage to their tissues. At the same time, levels of some cytokines — molecules used to exchange signals between cells — increase. In burns patients, levels of anti-inflammatory cytokines, such as the proteins interleukin-4 (IL-4) and interleukin-10 (IL-10), go up.

As well as calming inflammation, these molecules also suppress the ability of immune cells that usually attack pathogens. This leaves burns patients more vulnerable to long-lasting infections.

When athletes over-reach, Smith suggests, they similarly damage muscle, prompting an immune response. When she measured interleukin levels in athletes before and after a marathon, she found that IL-10 levels shot up, although IL-4 remained constant². This too could leave them vulnerable, she says.

But this is unlikely to be the whole story, as athletes with UPS often complain of tiredness and aching joints when they are apparently infection-free.

A possible explanation for this comes from an academic who has personal knowledge of UPS. The condition hit Paula Ansley-Robson when she was attempting to break into the British Olympic rowing squad in 1996. "I was training for over 24 hours a week," she says. Then UPS struck. "After that, a 5-kilometre run felt like a marathon."

Now an exercise physiologist at the University of Portsmouth, UK, Ansley-Robson is interested in another cytokine, interleukin-6 (IL-6), levels of which often rise when someone has a cold or flu. It makes the sufferer feel tired, and is one of the signals that helps the body to slow down while fighting off an infection. It is also involved in regulating glucose energy stores during exercise. Levels of IL-6 can rise 100-fold during a marathon and are partly responsible for feelings of tiredness during a race.

Studies have shown that injections of IL-6 into healthy individuals will make them tired within a few hours. Some people are more sensitive to the cytokine than others. Chronic fatigue sufferers, for example, will become more tired more quickly, and for longer, than control subjects after injections of IL-6 (ref. [3](#)). Injecting a runner before a race will likewise have tiring effects; an experienced club runner typically has a minute added to their time for a 10-kilometre run³.

Sensitive issue

Ansley-Robson suspects that over-reaching itself sensitizes athletes to IL-6, making them more likely to feel worse effects from natural bursts of the cytokine. She plans to put runners through a gruelling test of this idea. Runners will first do a timed 10-km run after an IL-6 injection. They will then 'over-reach' by running an incredible 90 kilometres — more than twice as far as a marathon. After a few weeks of rest, they will have an IL-6 injection and run a second 10-km race. If over-reaching sensitizes them to IL-6, they will perform particularly poorly in this last test, she predicts.

In the meantime, athletes can take some precautions. Michael Gleeson, a sports scientist at Loughborough University, UK, recommends a minimum six-hour rest between training sessions, as IL-6 levels are significantly higher among subjects who rest for only three hours⁴. He also emphasizes the need for coaches to monitor athletes' mood. Psychological stress is thought to contribute to UPS, although no one knows why.

For Brennan, careful monitoring of his mood and health could have made all the difference. "After being ill I would train harder to make up for it," he says. It's an understandable reaction from an athlete dedicated to the idea that training produces results. Yet Brennan now recognizes that less is sometimes more. "If I had backed off for a couple of weeks it could all have been sorted out," he says.

But he didn't. So when the rowers take to the water in Athens, Brennan will be watching on TV — although his thoughts have already turned to the 2008 Olympics in Beijing. For those games, he fully intends to qualify — after a good, long rest .

[Box](#) *Cooling Off*

Carina Dennis explores the tricks athletes use to help them recover more quickly - including plunges into icy baths.

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