The Science of Running

Alex Hutchinson rounds up the latest in endurance research

A pregnant Paula Radcliffe running alongside her daughter Isla at the 2008 New York Mini 10K

Running and Pregnancy

THERE ARE PLENTY OF STORIES about elite runners who continue to run while pregnant. Canadian marathoner Krista DuChene, for example, has run through three pregnancies, getting faster after each one and registering a world-class time of 2:32 last year. But general guidelines about how much to exercise are harder to come by, since no one wants to conduct potentially risky experiments on pregnant women. That makes a recent randomized study by obstetricians in Texas, published in *Medicine & Science in Sports & Exercise*, particularly valuable.

The researchers assigned 62 sedentary women to either stay sedentary, or to do 45 to 60 minutes of moderate exercise (a mix of aerobics, walking, cycling, elliptical, and strength training) four times a week, starting at 12 to 14 weeks and continuing to 36 weeks or delivery. The results were encouraging: the exercising women gained fitness and strength, and were five times less likely to require a Caesarean section. They also recovered more quickly after delivery, and were slightly less likely to develop high blood pressure.

The study supports this amount of moderate exercise, based on American College of Obstetricians and Gynecologists guidelines, as a "minimum effective dose for exercise in pregnancy," says Bradley Price, the study's lead author. But it doesn't tell us anything about the maximum safe dose. A pair of recent studies have tackled that delicate question, including one that recruited six Norwegian Olympic runners and skiers (who between them had won 21 Olympic and World Championship medals) to exercise at very high intensities while 23 to 29 weeks pregnant.

At the very highest intensities, both studies observed a brief decrease in fetal heart rate and in blood flow to the uterus for a few minutes after exercise. The measurements returned to normal after a couple of minutes, and no adverse outcomes were reported – but it does raise questions about the existence of an upper safe limit. In both studies, the effect was only observed when women exceeded at least 90 per cent of their max heart rate. There isn't yet enough evidence to declare 90 per cent as an upper threshold, but it seems like a reasonable rule of thumb for the moment – especially since you can get a very, very challenging workout without exceeding it.

Drafting Calculations

EVERYONE KNOWS about the benefits of drafting for cyclists – as much as 39 per cent energy savings if you tuck in at the back of a group of riders travelling at 40 kilometres per hour. But even though runners move at much slower speeds, they can benefit too, especially on windy days. One study found that elite sprinters spend about eight per cent of their energy overcoming air resistance even on a calm day, while middle distance runners spend four per cent and marathoners spend two per cent. The numbers are much bigger on windy days – but by tucking close behind another runner, you can avoid about 80 per cent of those losses, which works out to around a second per lap in a one-mile track race. You have to get close to the runner in front of you, though. Wind tunnel experiments suggest that the optimal spot is between 60 and 80 cm directly behind the leader – though it's probably best to drop a little farther back if you're getting kicked in the shins.

Knowing Your Footstrike

HOW YOUR FOOT HITS the ground when running – heel first, forefoot first, or both at the same time – has become a hot topic among runners, with some research tentatively suggesting that forefoot strikers may be less injury prone than heel strikers. But it turns out that determining which camp you fall into is trickier than most people realize. Researchers at the University of North Carolina assembled two groups of runners: 22 who wore traditional running shoes and 35 who wore minimalist shoes. They asked the runners whether they were forefoot or heel strikers – and then they put them on a high-tech treadmill for a reality check.

While 20 of 22 in the traditional group said they were heel strikers, it turned out that all of them were heel strikers. In the minimalist group, on the other hand, all 35 claimed to be forefoot strikers, but 12 of them were actually heel strikers. The results offer a good reminder that your foot hits the ground very quickly, so it's hard to tell what's really happening without high-definition video or a treadmill. An interesting twist: while the forefoot-striking minimalists hit the ground with a slightly lower rate of force than the traditional shoe group, the heel-striking minimalists had by far the highest impact on landing. The message: how you run is at least as important as what shoes you wear.

'Supercompensating' Your Brain

ONE OF THE BENEFITS of training is that your muscles learn to store more carbohydrate, in the form of glycogen. A hard workout depletes your muscle glycogen stores. Then over the next 24 hours, they "supercompensate" and store even more glycogen than you started with. It turns out that the same process happens in your brain, according to a study published by Japanese researchers in the *Journal of Physiology*: vigorous exercise depletes your brain's glycogen stores, and that's followed by a period of supercompensation. If training is sustained over many weeks, your brain's baseline level of glycogen increases.

The brain is actually pretty greedy – under normal circumstances, it devours about 20 per cent of the sugars circulating in your blood. Adding extra fuel storage in the brain itself could be one of the reasons that aerobic exercise boosts cognitive function, the researchers suggest. It's also possible – though much more controversial – that a shortage of fuel in the brain is one of the factors that makes you feel like you have to stop during exhaustive exercise. If that's the case, then training the brain to supercompensate and store more fuel could help you run farther and faster.

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