Medical Xpress

New study shows that 'super spikes' can increase track running speed by 2%

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The researchers compared traditional running shoes to three commercially available superspikes. Credit: Montgomery Bertschy

New research published in the *Journal of Sport and Health Science* and led by the University of Massachusetts Amherst shows that super spikes,

scientifically described as advanced footwear technology (AFT) spikes, can give runners about a 2% edge in middle-distance track races, like the 800- and 1,500-meters.

"Track athletes started wearing super spikes about five years ago and they are now commonplace in elite track races," says Wouter Hoogkamer, assistant professor of kinesiology at UMass Amherst and senior author of the paper.

"Super spikes have a thicker yet lighter, more resilient and more compliant midsole often combined with a stiff-carbon-fiber plate embedded in the midsole," explains Montgomery Bertschy, a doctoral student in Hoogkamer's UMass Integrative Locomotive Lab and joint first author of the paper.

"Over the past five years many track records have been broken and that will not be much different during these Olympics," Hoogkamer adds. "Many credit the recent developments in spike technology for this, but scientifically, we don't know that they help. Are athletes running faster because the spikes are faster, or just because they are training better, or run on faster tracks?"

To answer this, Hoogkamer brought together an international team of researchers, including Ethan Wilkie, a graduate student at the University of New Brunswick in Canada, and Victor Rodrigo-Carranza, a then-graduate student at the University of Castilla-La Mancha in Spain.

Over a series of experiments, the researchers compared different designs of super spikes with a typical traditional track spike shoe: lightweight in construction with minimal cushioning and no added bending stiffness elements. They found that various designs of super shoes improved running speeds by about 2%, ranging from anywhere from 1.8% to 3.1%.

This begs the question: How much could a 2% speed improvement influence the competition?

"A lot," says Wilkie. "We're showing that shoes matter and particularly that spikes of some brands performed better than others. Historically, we can expect to see differences of less than 0.5% in race time determining who will win the gold, who will get silver, or will not make the podium. Our 2% findings highlight that some of that might be because some people have slightly better shoes than others."

"At the Olympics very few athletes will be running in traditional spikes, but it is important to realize that not all super spikes are equal," Hoogkamer adds. In the final experiment of the study, the researchers evaluated commercially available shoes. They found that the PUMA evoSPEED LD Nitro Elite+ and Nike ZoomX Dragonfly showed significant improvements in speed of about 2%, but a third model of a different brand showed only 1% improvement and that was statistically not better than the traditional spikes.

While Hoogkamer's previous research showed the benefit of super shoes in marathons, quantifying this for middle-distance track events came with unique challenges. To test the impact of super shoes on marathon runners, scientists typically measure the air that runners are breathing out while they run at marathon pace on a treadmill.

"When athletes run at middle-distance race pace, however, there's a substantial contribution of anaerobic energy metabolism that we don't capture by measuring the athletes' breaths," explains Rodrigo-Carranza. Instead, the researchers relied on their own experiences as (former) competitive middle-distance runners and developed a new protocol where they asked athletes to run a series of 200m intervals at a self-perceived middle-distance race pace, a common workout for middle-distance runners.

Bertschy highlights the scientific rigor that enabled this team to distill the impact of the shoe design from other variables specifically for middle-distance running performance. "From the literature, we know that shoe mass has an important effect on the metabolic cost of running, and that each 100 grams added to the foot, increases the energy cost of running by about 1%, which in its turn will slow down runners by 0.6% at these running speeds," he explains.

So, in their first experiment, they added 200 grams to each shoe of a pair of spikes that was identical to the control spikes to induce a 2% higher energy cost to the runner. They predicted that this would result in a 1.2% decrease in speed. If their predictions were right, it would validate that their methods were accurately capturing the effect of just the shoe. And it did just that.

Over in Spain, Rodrigo-Carranza then assessed the reliability of their new protocol by asking his participants to run in three different spike models not just once, but on three separate days. When assessing the group differences between the three spike models, the researchers found the exact same results on each of the three days, further proving the robustness of this protocol.

As for how super spikes make people faster, the researchers found that the runners took longer steps, rather than faster steps. "Our results also indicate that over a 1500m race, our participants would take 17 to 21 steps less in super spikes as compared to traditional spikes," says Hoogkamer.

Hoogkamer envisions the innovations that come with this new method. "Different brands are actually using this protocol now to evaluate their spikes and to find out what's best for a specific distance or for a specific athlete that is either stronger or heavier or faster," he says. "You can go to a specific athlete, have them test spikes with our new protocol and

find out: Do you need to wear spike A or B?"

As for what non-Olympians can take away from this study, he says it can help people understand that yes, athletes are training harder, but also: it's about the shoes.

"This study is mainly going to help them interpret what they see at the Olympics or when world records are broken—that part of it is because the shoes are getting better and better, and we have evidence for that."

More information: Montgomery Bertschy et al, Self-perceived middle-distance race pace is faster in advanced footwear technology spikes, *Journal of Sport and Health Science* (2024). DOI: 10.1016/j.jshs.2024.100975

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