

# Drafting can save minutes of marathoners' times, make official sub-2 possible

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On Sept. 25, Kenyan marathoner Eliud Kipchoge beat his own world record by 30 seconds, crossing the finish line at the Berlin Marathon in 2:01:09 and stepping tantalizingly close to the Holy Grail of the sport:

running 26.2 miles in under two hours in an officially-sanctioned race.

Drafting could play a critical role in getting him there, confirms new CU Boulder research published in the *Journal of Applied Physiology*.

Even better: This racing strategy could save three to five minutes for middle-of-the-packers, too, including those running Boulderthon 2022 or the Chicago Marathon this weekend.

"Our study confirms that drafting can make a huge difference," said senior author Rodger Kram, associate professor emeritus in the Department of Integrative Physiology. "Even elite marathoners are not taking full advantage of this."

### **Big debate, little research**

Run alone, even on a still day, and air molecules bump into you as you move through them, slowing you down. Run in the aerodynamic shadow of another runner, also known as drafting, and they push those molecules out of the way, so you don't have to work so hard.

Just how much energy runners can save by drafting has been a matter of debate since 1970, when British physiologist Griffith Pugh published a study concluding runners spend about 8% of their energy just pushing against air. This suggested an elite marathoner could shave as much as six minutes off his or her time via artful drafting. But the study involved just one subject running on a treadmill in a [wind tunnel](#). A subsequent study with three runners calculated the energy cost at about half that.

Kram and co-authors Edson Soares da Silva, of the Universidade Federal do Rio Grande do Sul in Brazil, and Wouter Hoogkamer, now at the University of Massachusetts Amherst, sought to set the record straight.

"This is the first study to reliably measure the performance benefits of drafting based on physiology," said Kram.

The team recruited 12 male runners to complete six 5-minute trials on a treadmill at six to eight minutes per mile. First, they ran normally. Then, instead of having wind blowing at them, they had a rubber strap pulling them back with either 4 or 8 newtons of force (about the weight of one or two full beer cans) to simulate the [aerodynamic drag](#) of running with pacers (other runners to draft off of) or without.

Among other things, Kram and his team measured the runners' oxygen consumption, or how much energy they expended under each scenario.

Bottom line: Pugh was right.

"Our number ends up being very similar to what he found with that single runner," said Kram.

The researchers conclude runners could theoretically increase their power by about 6% per 1% of their [body weight](#) in the absence of any wind resistance.

Realistically, even the most ideal drafting can probably only eliminate about 85% of that drag. And notably, for reasons that aren't yet clear, some runners appear to benefit even more from drafting than others.

For a runner of Kipchoge's size and speed, this means drafting alone can potentially save between 3:42 and 5:29.

Surprisingly, slower runners can achieve about the same time savings. For instance, da Silva calculates, a 125-pound, 5-foot-7 female runner who typically runs about a 3:35 marathon could improve her time by as much as five minutes.

"Anyone from top elite to lower-level marathoners could benefit from adopting the optimal drafting formation for as much of their race as they can," said da Silva.

### **An underappreciated secret weapon**

For the mere mortal runner seeking a personal record, simply ducking behind taller runners for a while can make a difference, Kram said. (Caution: On a hot day, this could backfire by blocking a cool breeze).

For Kipchoge, the challenge now is to find the perfect drafting formation and pacers who can keep up with him longer.

Under normal road racing rules, a [runner](#) can only have three pacers starting with them. In Berlin, three pacers ran in front of him and peeled off at the 15-mile mark. If the pacers could stick with Kipchoge for another 10 kilometers, the authors report, he could shave off another minute.

During Kipchoge's famous Ineos 1:59 challenge in 2019, he used rotating pacers to help him break two hours, in addition to wearing ideal shoes and running on an ideal course, all factors that can make a big difference, according Kram's previous research.

But the staged event was not an official race so, according to World Athletics, the running milestone has not yet been officially reached.

Kram is confident that day will come, and it could be soon.

"Mass participation marathon races are back, and there is a lot of built-up interest again in this quest to run a two-hour marathon," he said. "Kipchoge only has to shave off about a minute. More disciplined drafting could easily get him there."

**More information:** Edson Soares da Silva et al, The metabolic cost of emulated aerodynamic drag forces in marathon running, *Journal of Applied Physiology* (2022). [DOI: 10.1152/jappphysiol.00086.2022](https://doi.org/10.1152/jappphysiol.00086.2022)

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