

A Scientific Look at the Dangers of High Heels

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Illustration by Henrik Sorensen

Not long ago, Neil J. Cronin, a postdoctoral researcher, and two of his colleagues at the Musculoskeletal Research Program at Griffith University in Queensland, Australia, were having coffee on the university's campus



when they noticed a young woman tottering past in high heels. “She looked quite uncomfortable and unstable,” Dr. Cronin says.

Some observers, particularly women, might have winced in sympathy or, alternatively, wondered where she'd bought stilettos. But the three researchers, men who study the biomechanics of walking, were struck instead by the scientific implications of her passage. “We began to consider what might be happening at the muscle and tendon level” in women who wear heels, Dr. Cronin says.

How shoes affect human gait is a controversial topic these days. The popularity of barefoot running, for instance, has grown in large part because of the belief, still unproven, that wearing modern, well-cushioned running shoes decreases foot strength and proprioception, the sense of how the body is positioned in space, and contributes to running-related injuries.

Whether high heels might likewise affect the wearer's biomechanics and injury risk has received scant scientific attention, however, even though millions of women wear heels almost every day. So, in one of the first studies of its kind, the Australian scientists recruited nine young women who had worn high heels for at least 40 hours a week for a minimum of two years. The scientists also recruited 10 young women who rarely, if ever, wore heels to serve as controls. The women were in their late teens, 20s or early 30s.

The scientists asked the heel-wearing women to bring their favorite pair of high-heeled shoes to the lab. There, both groups of women were equipped with electrodes to track leg-muscle activity, as well as motion-capture reflective markers. Ultrasound probes measured the length of muscle fibers in their legs.

All of the women strode multiple times along a 26-foot-long walkway that contained a plate to gauge the forces generated as they walked. The control group covered the walkway 10 times while barefoot. The other women walked barefoot 10 times and in their chosen heels 10 times.

It was obvious, as the scientists had suspected watching the woman during their coffee break, that the women habituated to high heels walked differently from those who usually wore flats, even when the heel wearers went barefoot. But the nature and extent of the differences were surprising. In results [published last week in The Journal of Applied Physiology](#), the scientists found that heel wearers moved with shorter, more forceful strides than the control group, their feet perpetually in a flexed, toes-pointed position. **This movement pattern continued even when the women kicked off their heels and walked barefoot. As a result, the fibers in their calf muscles had shortened and they put much greater mechanical strain on their calf muscles than the control group did.**

In that control group, the women who rarely wore heels, walking primarily involved stretching and stressing their tendons, especially the Achilles tendon. But in the heel wearers, the walking mostly engaged their muscles.

That biomechanical distinction is important, says Dr. Cronin, who is now a researcher at the University of Jyväskylä in Finland. “Several studies have shown that optimal muscle-tendon efficiency” while walking “occurs when the muscle stays approximately the same length while the tendon lengthens. When the tendon lengthens, it stores elastic energy and later returns it when the foot pushes off the ground. Tendons are more effective springs than muscles,” he continues. So by stretching and straining their already shortened calf muscles, the heel wearers walk less efficiently with or without heels, he says, requiring more energy to cover the same amount of ground as people in flats and probably causing muscle fatigue.

The obvious question raised by the findings, though, is so what? Does it fundamentally matter if a woman's calf muscle fibers shorten and she neglects her tendons while walking, especially if she loves the looks of her Louboutins?

That question is difficult for a biomechanist to answer, Dr. Cronin admits. Aesthetics are outside the realm of his branch of science. But the risk of injury is not. "We think that the large muscle strains that occur when walking in heels may ultimately increase the likelihood of strain injuries," he says. (This risk is separate from the chances that a woman, if unfamiliar with heels, may topple sideways and twist an ankle or bruise her self-image, which is an acute injury and happened to me only the one time.)

The risks extend to workouts, when heel wearers abruptly switch to sneakers or other flat shoes. "In a person who wears heels most of her working week," Dr. Cronin says, the foot and leg positioning in heels "becomes the new default position for the joints and the structures within. Any change to this default setting," he says, like pulling on Keds or Crocs, constitutes "a novel environment, which could increase injury risk."

It should be noted, he adds, that in his study, the volunteers "were quite young, average age 25, suggesting that it is **not necessary to wear heels for a long time, meaning decades, before adaptations start to occur.**"