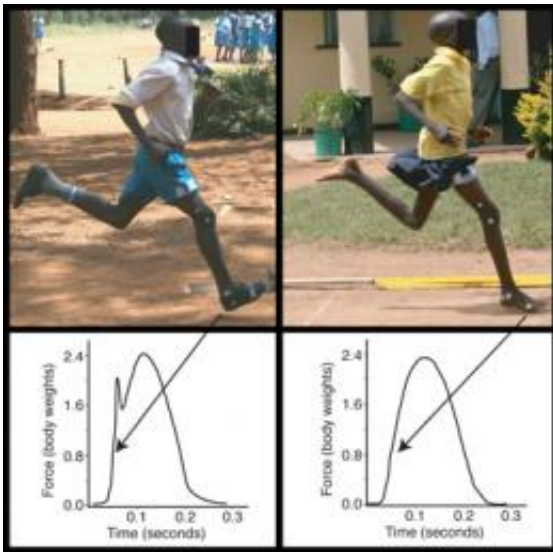


Study finds barefoot runners have less foot stress than shod ones (w/ Video)

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On the left, a habitually shod Kenyan who is heel-striking; on the right, a Kenyan who has never worn shoes and who is forefoot striking in the way most barefoot runners land. Below are representative force traces (in units of body weight) showing how the two styles of running differ in the force generated when the foot collides with the ground. The barefoot runner lands with no collisional force. Image: Daniel E. Lieberman

(PhysOrg.com) -- New research is casting doubt on the old adage, "All you need to run is a pair of shoes."

Scientists have found that those who run barefoot, or in minimal footwear, tend to avoid "heel-striking," and instead land on the ball of

the foot or the middle of the foot. In so doing, these [runners](#) use the architecture of the foot and leg and some clever Newtonian physics to avoid hurtful and potentially damaging impacts, equivalent to two to three times body weight, that shod heel-strikers repeatedly experience.

"People who don't wear shoes when they run have an astonishingly different strike," says Daniel E. Lieberman, professor of human [evolutionary biology](#) at Harvard University and co-author of a paper appearing this week in the journal *Nature*. "By landing on the middle or front of the foot, barefoot runners have almost no impact collision, much less than most shod runners generate when they heel-strike. Most people today think barefoot running is dangerous and hurts, but actually you can run barefoot on the world's hardest surfaces without the slightest discomfort and pain. All you need is a few calluses to avoid roughing up the skin of the foot. Further, it might be less injurious than the way some people run in shoes."

Working with populations of runners in the United States and Kenya, Lieberman and his colleagues at Harvard, the University of Glasgow, and Moi University looked at the running gaits of three groups: those who had always run barefoot, those who had always worn shoes, and those who had converted to barefoot running from shod running. The researchers found a striking pattern.

Most shod runners -- more than 75 percent of Americans -- heel-strike, experiencing a very large and sudden collision force about 1,000 times per mile run. People who run barefoot, however, tend to land with a springy step towards the middle or front of the foot.

"Heel-striking is painful when barefoot or in minimal shoes because it causes a large collisional force each time a foot lands on the ground," says co-author Madhusudhan Venkadesan, a postdoctoral researcher in applied mathematics and human evolutionary biology at Harvard.

"Barefoot runners point their toes more at landing, avoiding this collision by decreasing the effective mass of the foot that comes to a sudden stop when you land, and by having a more compliant, or springy, leg."

The differences between shod and unshod running have evolutionary underpinnings. For example, says Lieberman, our early Australopith ancestors had less developed arches in their feet. *Homo sapiens*, by contrast, has evolved a strong, large arch that we use as a spring when running.

"Our feet were made in part for running," Lieberman says. But as he and his co-authors write in *Nature*: "Humans have engaged in endurance running for millions of years, but the modern running shoe was not invented until the 1970s. For most of human evolutionary history, runners were either barefoot or wore minimal footwear such as sandals or moccasins with smaller heels and little cushioning."

For modern humans who have grown up wearing shoes, barefoot or minimal shoe running is something to be eased into, warns Lieberman. Modern running shoes are designed to make heel-striking easy and comfortable. The padded heel cushions the force of the impact, making heel-striking less punishing.

"Running barefoot or in minimal shoes is fun but uses different muscles," says Lieberman. "If you've been a heel-striker all your life you have to transition slowly to build strength in your calf and foot muscles."

In the future, he hopes, the kind of work done in this paper can not only investigate barefoot running, but can provide insight into how to better prevent the repetitive stress injuries that afflict a high percentage of runners today.

"Our hope is that an evolutionary medicine approach to running and

sports injury can help people run better for longer and feel better while they do it," says Lieberman, who has created a web site, www.barefootrunning.fas.harvard.edu, to educate runners about the respective merits of shod and barefoot [running](#).

Provided by Harvard University

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