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BAREFOOT RUNNING: WHAT THE HARVARD STUDY REALLY SAID

Friday, February 19, 2010 | Category: [Training](#)



The running pot is simmering in the popular press these days, and the heady vapor which is emerging proclaims that barefoot running provides the pathway to salvation for a large fraction of the running population.

You're familiar with the claims by now: That barefoot running erases existing running injuries. That barefoot running reduces the risk of future running maladies. That barefoot running is healthier and more natural than shod running. That barefoot running diminishes impact forces and the rate at which those collision forces are transmitted up the legs. That barefoot

running can even improve performances.

Soon we will hear that barefoot running lowers the risk of some forms of cancer.

The acute hubbub surrounding barefoot running is the result of the publication of both Christopher McDougall's New-York-Times-best-selling book, *Born to Run*, and a paper entitled "Foot Strike Patterns and Collision Forces in Habitually Barefoot versus Shod Runners," which debuted in the prestigious journal *Nature* on January 28 of this year. Aided by seven colleagues from a variety of institutions, Daniel Lieberman of the Department of Human Evolutionary Biology at Harvard University was the principal investigator in the *Nature* study. Lieberman *et al* looked at the kinematics and kinetics of running in five different groups: (1) Habitually shod athletes from the USA, (2) Currently shod runners from the Rift Valley in Kenya who grew up running barefooted, (3) Runners from the USA who began running in the shod condition but have now adopted a barefoot-running lifestyle, (4) Adolescent Kenyan harriers who have never worn shoes, and (5) Adolescent Kenyan runners who have run shod for most of their lives.

Ironically, the popular press has been using the Harvard study as a launching pad for the idea that barefoot running is healthier than shod ambling, even though Lieberman's paper provided no data at all to test the idea that barefoot running lowers the risk of running injuries!

Here's what Lieberman *et al* actually found:

(A) Habitually shod runners (groups 1 and 5 from above) who grew up wearing shoes are usually rear-foot strikers (RFS), meaning that their heels make the first impacts with the ground during running, right at the beginning of the stance phase of gait. This is not new information. The strong link between running in shoes and heel-striking has been known for many years.

(B) Runners who grew up running barefooted or who switched to running barefooted (groups 2, 3, and 4) are generally fore-foot strikers (FFS), meaning that they tend to land initially on the balls of their feet while running, after which their heels drop down to make contact with the ground. Again, this is nothing new – the tight connection between barefoot running and FFS (and also MFS, mid-foot striking) has been general knowledge for years.

(C) Impact forces transmitted through the foot, ankle, and leg immediately after impact with the ground are about three times greater in shod runners using RFS, compared with barefoot runners with FFS. Some – but not all - previous studies have shown this same relationship, with RFS producing greater impact force during the first portion of stance, compared with MFS and FFS. The sudden rise in force with RFS, immediately after ground contact, is known as the "impact transient." The disparity in impact transient between barefoot and shod running represents a "foundation" for the belief that barefoot running is "safer" and less injury producing. While this appears to be logical thinking, it is

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important to know that no study has ever shown that greater impact forces during the first portion of stance magnify the risk of running injury.

(D) Rates of loading of impact force are actually quite similar between shod RFS runners and barefoot FFS athletes (Figure 2b from the *Nature* paper). The rate at which impact force is loaded into the leg has also been suggested to be a risk factor for injury, although convincing proof of this notion does not exist.

(E) During the early stance phase of barefoot FFS running, there is greater knee flexion, greater dorsi-flexion at the ankle, and a 74-percent-greater drop in the center of mass, compared with shod RFS running. "Vertical compliance" is defined as the drop in the runner's center of mass relative to the vertical force during the impact period of stance, and it is obviously greater in barefoot FFS running, compared with shod RFS. Vertical compliance varies as a function of running-surface hardness, and this is why force-loading rates are similar for barefoot FFS runners over a wide array of running surfaces (the runners adjust compliance according to surface). This is not novel information, however.

(F) During barefoot FFS ambling, the ground reaction force torques the foot around the ankle (and therefore increases the amount of work carried out by the ankle, compared with shod RFS running). With shod RFS running, the ankle converts little impact energy into rotational energy. Potentially, this could spike the rate of ankle-area injuries (for example in the Achilles tendon and calf) for barefoot runners, although this hypothesis has not been tested.

And that was pretty much it! The *Nature* investigation did disclose some interesting information about the effective mass of the foot and shank (which we won't discuss here), but it offered no other information about the potential links between barefoot running and either injury or performance.

And that's why it's too early for you to consider changing from shod to barefoot running, unless such a shift would be a lot of fun for you. There's just no proof that barefoot running will reduce your risk of injury or make you faster.

In fact, it's important to remember that most injuries in running are caused by an imbalance between the strain and micro-damage experienced by a muscle or connective tissue during training and the tissue's ability to recover from such stress. This imbalance can occur when training is conducted shod – or barefooted! A weak or overly tight hamstring muscle which has been undone by excessive mileage won't care if its owner was running barefooted or wearing shoes – it will still feel the pain.

Now it is certainly true that barefoot and shod running are different from kinematic and kinetic standpoints, and this may have a bearing on injury rates. Shod running, at least shod running in big-heeled modern running shoes, almost automatically means RFS. With RFS, the ankle plantar-flexes immediately after impact as the bottom surface of the foot moves downward to make contact with the pavement. This places the shin muscles under strain immediately after heel impact, as they have to control this significant plantar flexion. In contrast, during barefoot (FFS or MFS) running the ankle immediately dorsi-flexes after impact, placing eccentric strain on the Achilles tendon and calf muscles as they attempt to control dorsi-flexion. Thus, it's possible that shod RFS might be linked with a higher risk of shin injuries, while barefoot FFS and MFS could be connected with a greater rate of Achilles and calf maladies. This notion has not been tested yet, however.

One thing is for certain: If you throw your running shoes in the trash bin and embark on your usual training program in the barefoot condition, you will probably soon be calling your sports-medicine physician (and perhaps looking for that trash bin). This is because if you have been running in shoes you are probably a RFS runner, and when you change to the naked-foot condition you will most likely become MFS or FFS. This will change the forces applied to various parts of your lower limbs, and – specifically – your Achilles and calf will come under pressures which they have not encountered before in your lifetime as a runner. So, please proceed cautiously if you decide to let the skin hit the road.

What does EducatedRunner recommend? The use of very comfortable, relatively minimal running shoes which permit actual proprioception, protect the bottoms of the feet from rough surfaces, and are conducive to mid-foot striking (MFS). From a performance standpoint, this overall strategy should eliminate the braking action commonly associated with RFS (the foot tends to land out in front of the center of mass, creating a slowing effect with RFS) and thus should upgrade speed and enhance economy. A shift from RFS to MFS will also eliminate the "impact transient" which *might* be a cause of running injury, and it will heighten the compliance of the leg, fostering the ability to run on surfaces of increased hardness without amplifying the impact forces experienced by the legs. MFS also tends to lead to an increased cadence while running (> 180 steps per minute), which EducatedRunner believes

is a good thing.

When you make this shift from RFS to MFS, however, be sure to do it *gradually*. Abruptly changing from 40 miles per week of RFS to the same volume with MFS is a sure way to find the Achilles heel in your running program.

COMMENTS

Good analysis... even Lieberman doesn't say that the study proves barefoot running is better for you or safer; he suggests that as an area of inquiry.

FWIW, I switched to barefoot without a problem, but I was a sprinter first, so I'm used to forefoot striking.

And, when I switched I also wanted a bit of extra protection from various things lying on the ground, which is what got me into the most minimalist shoe I could think of, namely huaraches.

And after making running sandals for many of the Boulder Barefoot Running Club, I ended up starting www.InvisibleShoe.com, which features "how to make huaraches" videos, running sandal kits, and custom made running sandals.

-Steven

posted @ Sunday, February 21, 2010 1:48 AM by Steven Sashen

Excellent summary and recommendations. One thing to note is that there are alarmingly few running shoes, especially trainers, without a heel lift. Even racing flats are anything but flat.

We've cut open dozens of the most popular running shoes on the market and found that typical light weight racing flats have a 6-12 mm heel lift and typical trainers 12 - 22 mm (almost an inch for the Kayakon 15 for example.)

Newton Running shoes have between 2 and 5 mm lift, which settles to 0 - 2 mm as they break in. Even Vibram Five Fingers have up to 2 mm lift.

posted @ Sunday, February 28, 2010 5:39 PM by Ian

Just wanted to let you know that there are existing studies that prove the natural running form (barefoot form combined with foot/leg/hip reaction to impact sensing) decreases the risk of injury, and also is more efficient for running (not walking or sprinting). See "The effect of running shoes on lower extremity joint torques" American Academy of Physical Medicine and Rehab, 2009 which proves the lower risk of injury. There is an Italian study which proves lower fuel consumption for the same distance traveled while running (not walking or sprinting) with natural form and heel not significantly raised relative to midfoot like 99% of modern running shoes.

posted @ Monday, March 01, 2010 10:22 AM by James Munnis

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posted @ Sunday, April 18, 2010 9:03 PM by Retro Jordan

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