

Foot strike patterns and collision forces in habitually barefoot versus shod runners

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Introduction

- Humans have engaged in endurance running for millions of years, but modern running shoes were not invented until the 1970's.
- Researchers explored how runners struck the ground before the invention of modern running shoes.
- Before the invention of modern running shoes, most runners ran barefoot or in minimal footwear such as sandals.



Review of Literature

- The human heel pad cushions impact transients, but to a lesser extent (Chi and Schmidt, 2005; Ker et al., 1989; De Clercq et al., 1994).
- Habitually shod runners tend to adopt a flatter foot placement when barefoot than when shod, thus reducing stresses on the foot (Dewit et al., 2000; Divert et al., 2005; Eslami et al., 2007; Squadrone et al., 2009).



Hypothesis

- In this study, researchers investigated fore-foot and mid-foot strike patterns in relation to barefoot and shod running.

Methods I

- Five Groups
 - Habitually shod amateur and collegiate athletes from Harvard University
 - Adult athletes from Rift Valley Province of Kenya
 - All habitually shod but 75% did not wear shoes until late teens
 - Self-identified habitual barefoot runners from the USA
 - Habitually barefoot group from rural primary school in Nandi District from Kenya
 - Habitually shod from urban primary school in Eldoret
 - All children unshod since early childhood



Methods II

- **Criteria:**
 - Ran a minimum of 20 km per week
 - No history of injuries
- **All subjects**
 - Ran on flat track ways 20-25 m long
 - Recorded via a high-speed video camera placed 0.5 meters above ground

Methods III

- Groups 1,2,3 and 5 were recorded in barefoot AND in shoes.
 - Not group 4 because they have NEVER worn shoes
 - Groups 1 and 2 wore a neutral Asics shoe.
 - Groups 3 and 5 wore their own shoes.
- Impact force was recorded for runners in groups 1 and 3 (barefoot and shoes).
- Kenyan runners were not recorded on force plate.



Methods IV

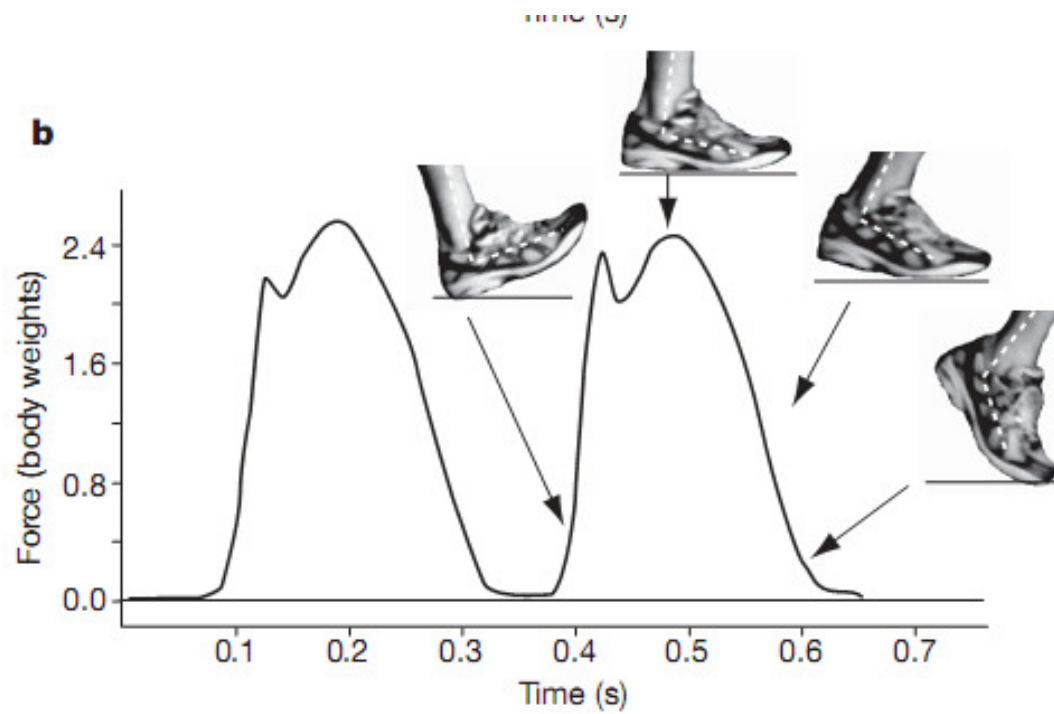
- Subjects asked to run at preferred speed.
- Subjects recorded for 5-7 trials.
 - One minute rest to avoid fatigue



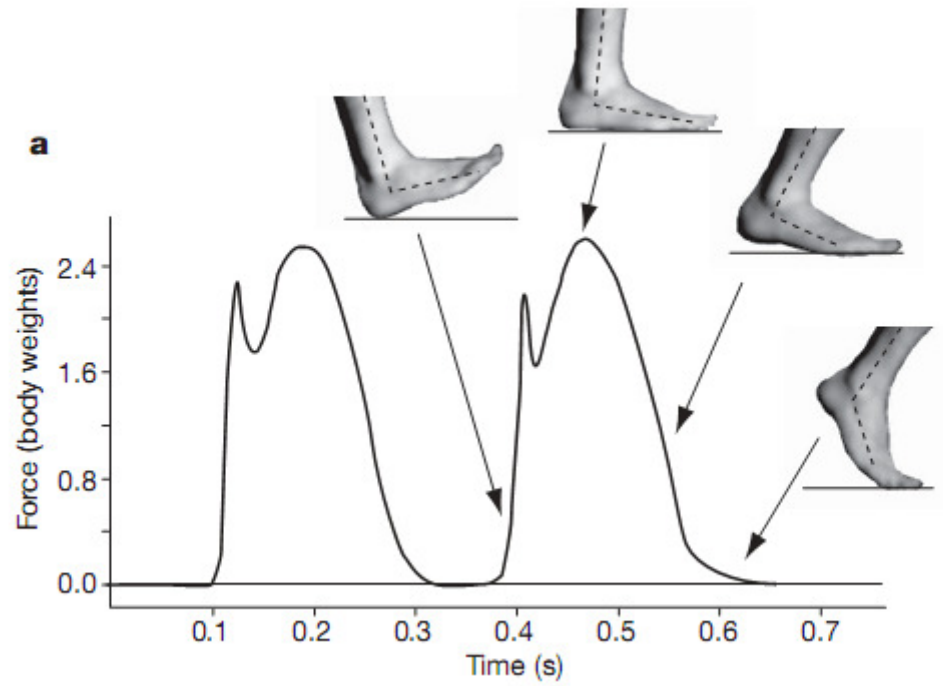
Results I

- Habitually shod runners who grew up wearing shoes rear-foot strike (groups 1 and 5).
- Runners who grew up barefoot or switched to barefoot fore-foot strike.
- Both groups sometimes land mid-foot strike in barefoot condition.
- Major factor in rear-foot strike in shod is cushioned heel orienting the sole as to have 5 degrees less dorsiflexion.

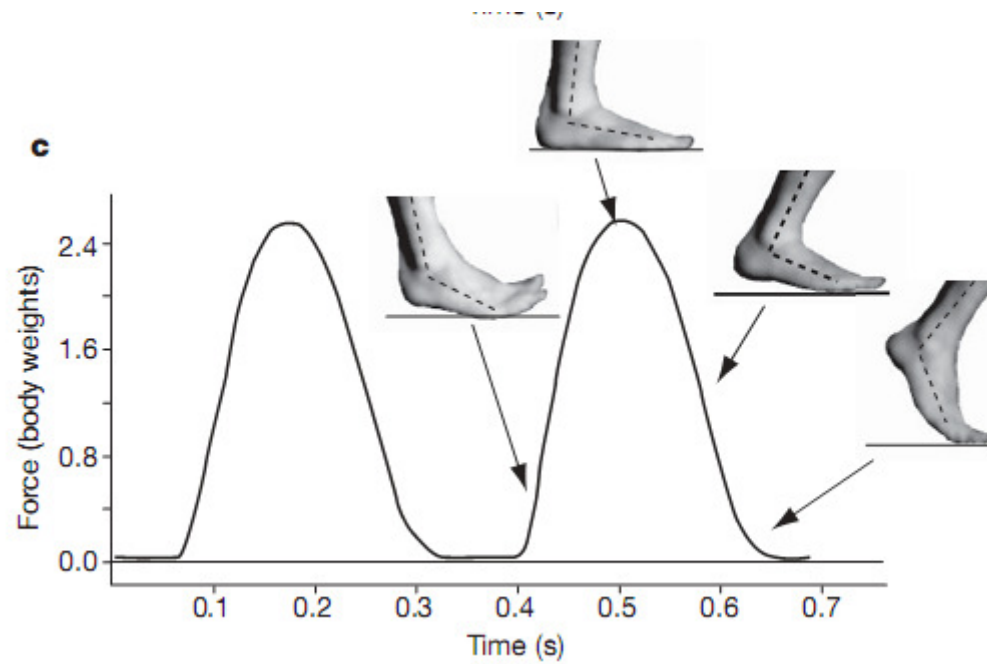
Results II



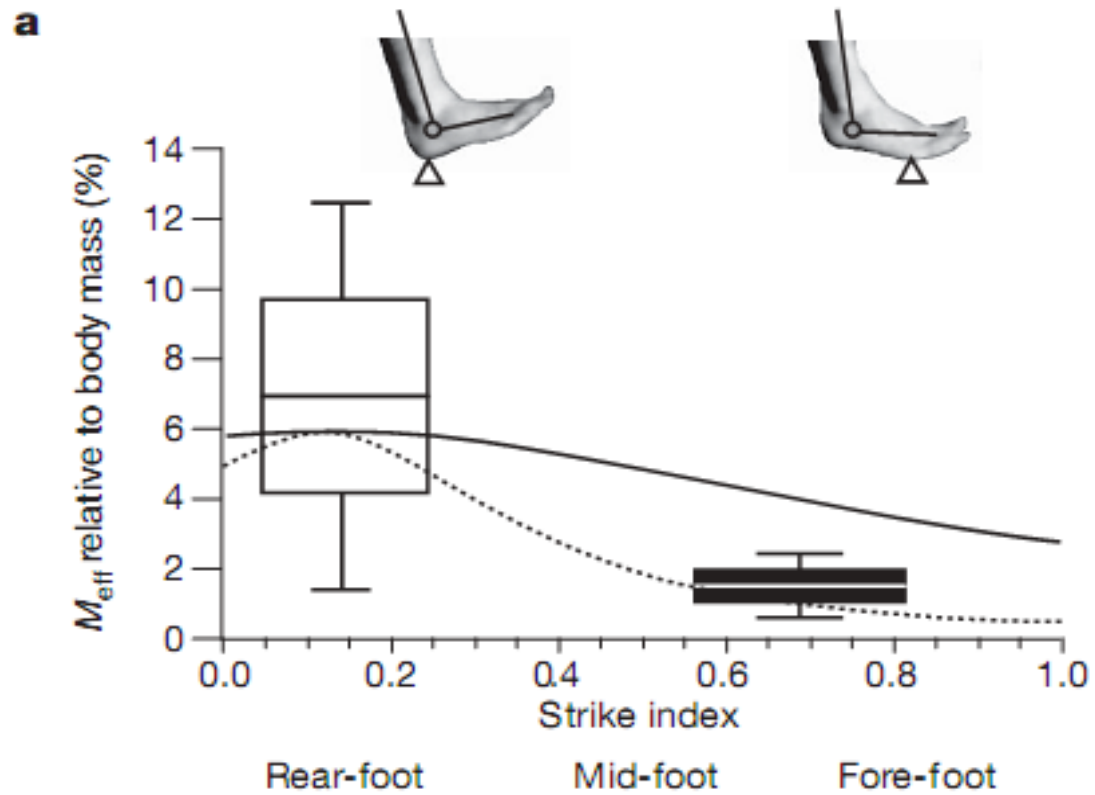
Results III



Results IV



Results V





Discussion I

- How runners strike the ground affects vertical leg compliance which is the drop in the body's center of mass relative to vertical force during impact.
- Vertical leg compliance is greater in FFS leading to lower rate of loading.



Discussion II

- Differences between RFS and FFS running make sense from an evolutionary perspective.
 - Most shod runners today land only on their heels.
 - Runners who run barefoot or wear minimalist shoes avoid RFS.



Conclusion

- RFS and FFS impact rates may lead to health implications.
 - Runners may be prone to repetitive stress injuries.
 - Less proprioception
 - Controlled studies are needed to test the hypothesis that individuals who do not RFS have reduced injury rates.



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