

# Differences in Exercise Economy between Minimalistic and Conventional Footwear

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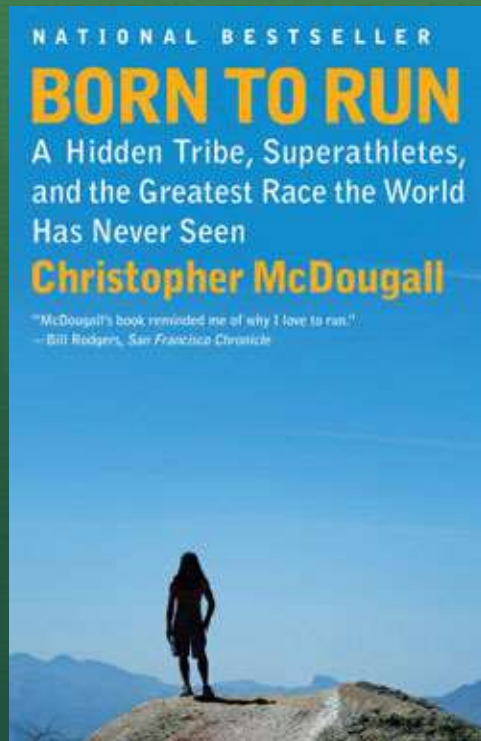
# Running

“Every morning in Africa, a gazelle wakes up. It knows it must outrun the fastest lion or it will be killed. Every morning in Africa, a lion wakes up. It knows it must run faster than the slowest gazelle, or it will starve. It doesn't matter whether you're a lion or a gazelle – when the sun comes up, you'd better be running.”

-(McDougall, 2009, p. 13)



# Inspiration: Tarahumara



[www.chrismcdougall.com](http://www.chrismcdougall.com)



[www.nytimes.com/2009/10/27/health/27well.html?\\_r=1](http://www.nytimes.com/2009/10/27/health/27well.html?_r=1)

# Pre-Modern Running Shoe

- Minimalistic in structure
  - Very thin-soled
  - No motion control
  - No heel pad or arch
- Promoted strong feet
  - Lower incidence of knee injuries



[www.runblogrun.com](http://www.runblogrun.com)

# Modern Running Shoe

- Invented by Nike in 1972
- Continually “improving” shoe technology
  - “Rear foot control”
  - “Cushioning”
  - “Shock distribution”
  - “Heel stabilization”
  - “Arch support”





# Running Injuries

- 79% of runners injured each year
  - Rates are NOT improving, despite the supposed improvements in shoe technology

-“How come my foot hurts?”

*-“Because running is bad for you”*

-“Why is running bad for me?”

*-“Because it makes your foot hurt”*

# The Problem

- Altered biomechanics
  - Knee flexion torque ↑ 36%
  - Knee varus torque ↑ 38%
  - Hip internal rotation torque ↑ 54%
- Altered physiology
  - Weakened intrinsic musculature
  - Little/no elastic recoil from muscles & tendons
  - ↑ impact & ground reaction force

# The Problem

- “Top-of-the-line” shoes = 123% *more* likely to be injured
- >\$95 shoes more than twice as likely as <\$45



[www.donnaluder.com/footmechanic/shapesize/](http://www.donnaluder.com/footmechanic/shapesize/)



[www.vibramfivefingers.com](http://www.vibramfivefingers.com)

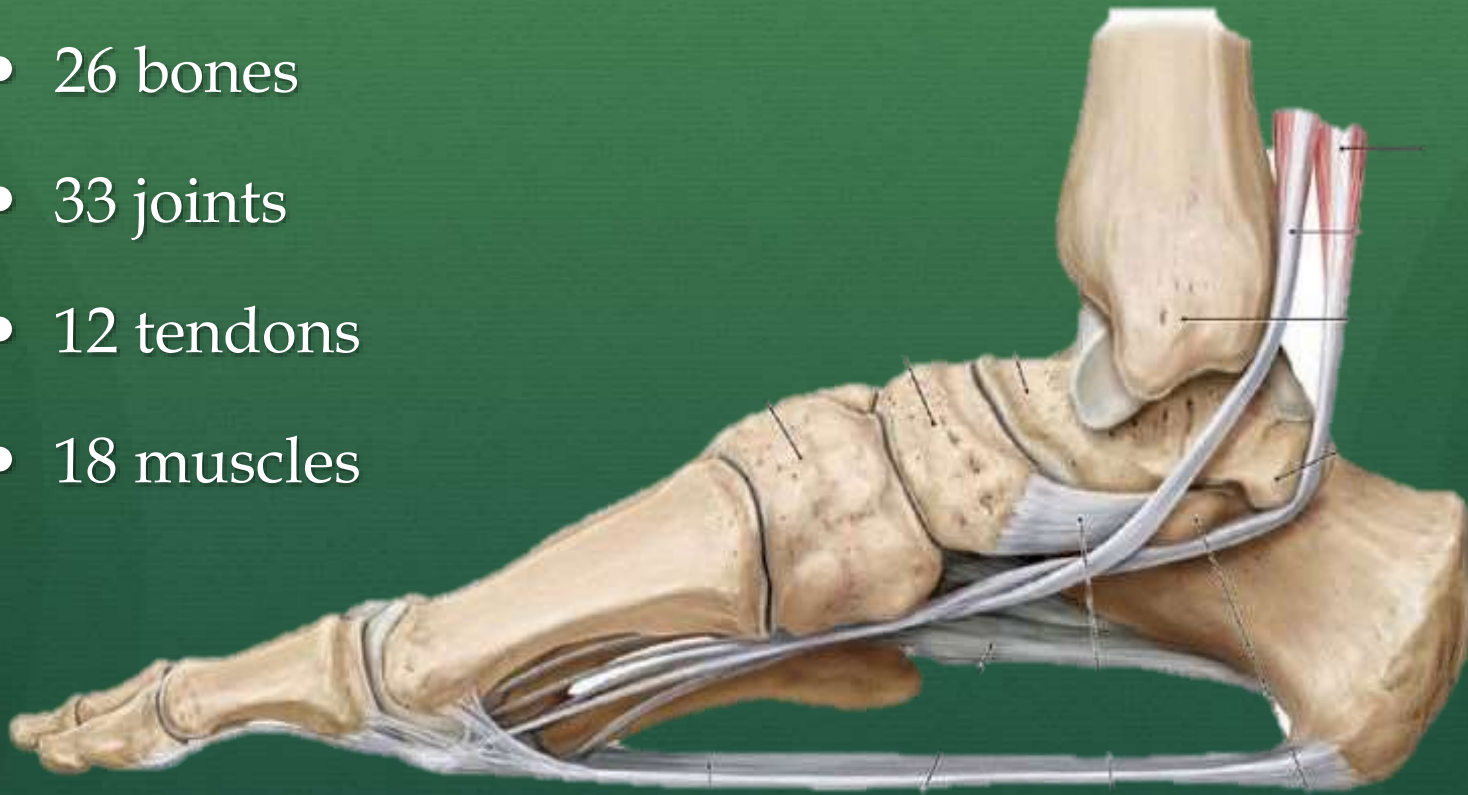


# Human Foot



[www.firstscience.com](http://www.firstscience.com)

- 26 bones
- 33 joints
- 12 tendons
- 18 muscles



[www.donnaluder.com/footmechanic/shapesize/](http://www.donnaluder.com/footmechanic/shapesize/)

# Why Minimalistic?

- Mimics barefoot running
- Protects feet from small hazards
- Stresses feet and provides no support



[www.thatsfit.com](http://www.thatsfit.com)



[www.tomsunderground.com](http://www.tomsunderground.com)

# Is “barefoot” better?

- Stronger feet = greater injury resistance
- More elastic energy = better exercise economy...?

- Barefoot offers no metabolic advantage.

- 4.6% greater  $VO_2$  response in shoes than barefoot.



- Shoes: 2.1% lower  $VO_2$  than barefoot

- 150g shoes: no change,  
350g shoes: 3.4% higher  $VO_2$



# The Experiment

- Vibram FiveFingers shown to accurately mimic barefoot metabolic response

Asics Gel  
Nimbus-12  
340g



Vibram  
FiveFingers  
KSO 161g



# Goal

- Discover whether it is more metabolically efficient, in terms of exercise economy, to run in conventional running shoes or minimalistic footwear.

# Hypothesis

- Based on a combination of studies and my own level of comfort with running “barefoot,” I hypothesized that it would be between two and five percent more efficient for me to run “barefoot” than shod.



# Methodology

- Establish  $VO_{2\max}$  on treadmill
- Run 2 sessions per day x 3 days
  - First session: Asics running shoes
  - Second session: Vibram FiveFingers
- Session length: 15 minutes
- Rest period: 15-20 minutes



# Methodology

- Treadmill settings:
  - 7.0 mph
  - 0.0% incline
- Information collected every minute
  - Data analyzed for minutes 6-15 (steady state)
    - Oxygen uptake ( $\text{VO}_2$ )
    - Heart rate (BPM)
    - Rate of perceived exertion (6-20)



# Results

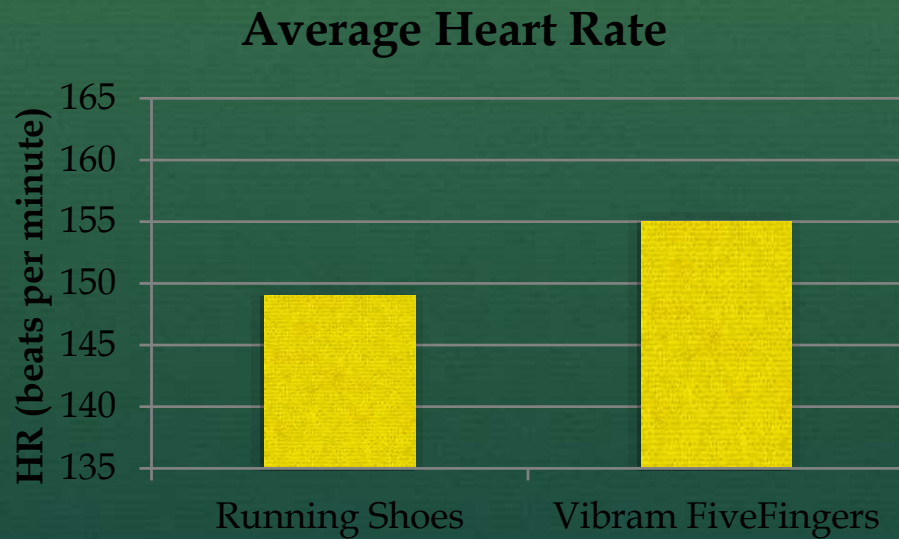
- Average metabolic cost
  - Running Shoes: 66.95% of  $VO_{2max}$
  - Vibram FiveFingers: 63.54% of  $VO_{2max}$
  - Difference: 3.41%





# Results

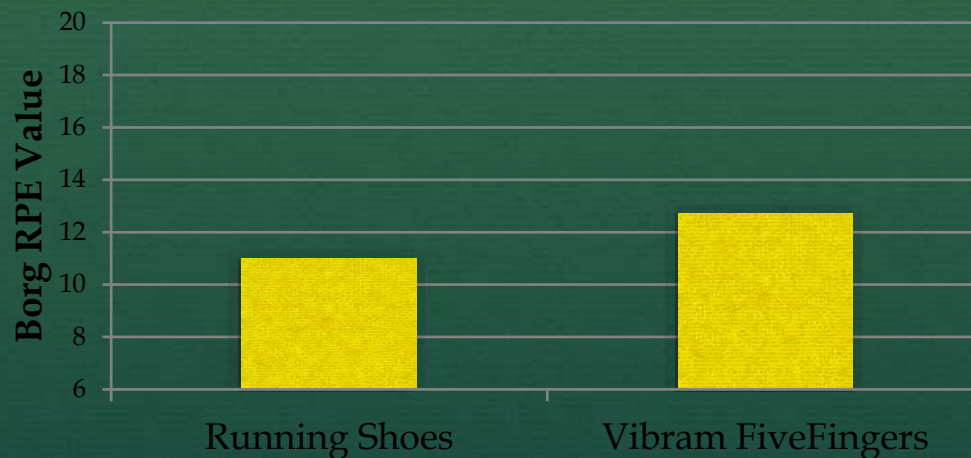
- Average heart rate
  - Running Shoes: 149 bpm
  - Vibram FiveFingers: 155 bpm
  - Difference: 6 bpm (3.03% of APMHR 198)



# Results

- Average rate of perceived exertion (RPE)
  - Running Shoes: 11
  - Vibram FiveFingers: 12.7
  - Difference: 1.7 (12.14% of 6-20 scale)

Average Rate of Perceived Exertion (RPE)



# Conclusion

- For me, it is about 3.41% more efficient, in terms of exercise economy, to run in minimalistic footwear (or barefoot) than it is to run in conventional shoes.
- These results are personal and could vary among other runners with different biomechanics and predispositions.
- This carries important implications in potential racing scenarios...



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Thank you!