

12-2022

A Review of the Benefits, Risks, and Guide to Adopting Barefoot Running

Joe Wallace
Grand Valley State University

Follow this and additional works at: <https://scholarworks.gvsu.edu/honorsprojects>

ScholarWorks Citation

Wallace, Joe, "A Review of the Benefits, Risks, and Guide to Adopting Barefoot Running" (2022). *Honors Projects*. 904.

<https://scholarworks.gvsu.edu/honorsprojects/904>

This Open Access is brought to you for free and open access by the Undergraduate Research and Creative Practice at ScholarWorks@GVSU. It has been accepted for inclusion in Honors Projects by an authorized administrator of ScholarWorks@GVSU. For more information, please contact scholarworks@gvsu.edu.

Barefoot Running

By: Joe Wallace



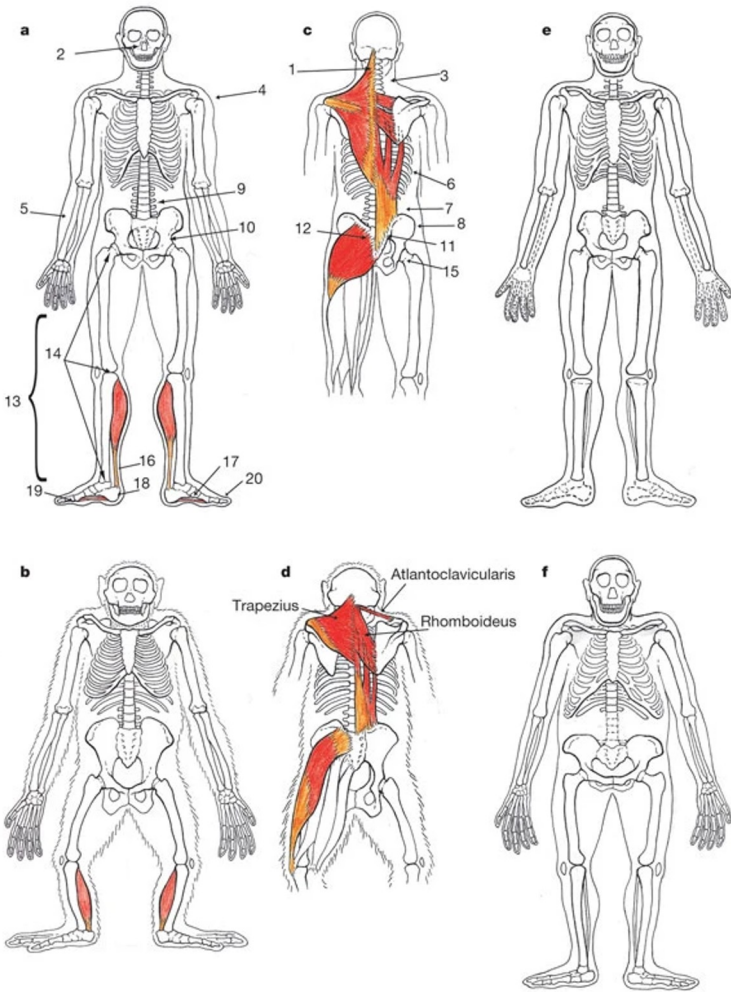


Why do humans run?

- Humans began running to run down our prey. Humans are elite endurance runners compared to other animals (Bramble, 2004).
- Humans have adaptations that make us better endurance runners including our achilles tendons, IT bands, long legs, and less hair compared to other animals (Bramble, 2004).
- We started out running barefoot, and our first footwear was for the purpose of thermal and mechanical protection (Zipfel, 2007).

Anatomical advantages

- This photo highlights differences between humans and primates that enable humans to be better endurance runners.
- Unlike primates, humans have long spring-like tendons that act as springs to make running more metabolically efficient (Bramble, 2004).
- Two of these long tendons are the achilles tendon (16) and the IT band (12).
- Having longer tendons enables us to stretch our tendons more and therefore produce more energy with each step





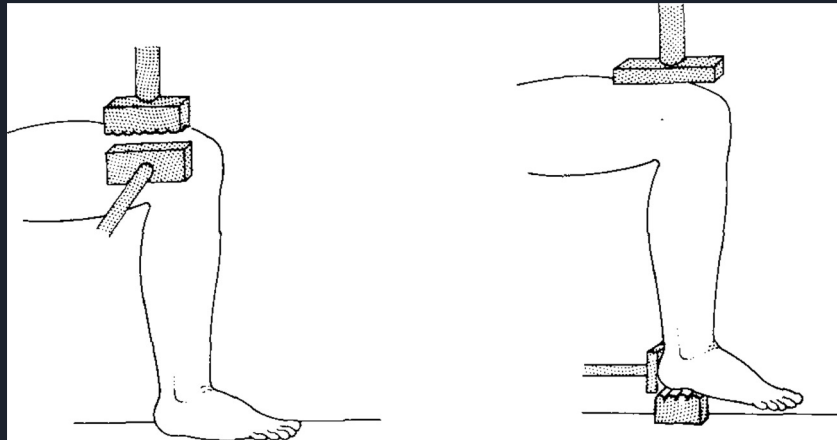
Why are people interested in barefoot running?

- People are interested in barefoot running because it could help prevent injuries. Humans started out running barefoot, so this is the natural way for us to run.
- 30-70% of runners are consistently injured every year (Lieberman, 2012).
- We've been focused on improving quality of shoes to prevent injury, and it has not caused any improvement in injury prevalence (Lieberman, 2012).
- In a survey, 34.3% of participants said they were interested in barefoot running for the purpose of preventing future injury (Rothschild, 2012).
- Some people also started barefoot running to improve running performance (Hryvniak, 2014).
- 20.8% of survey participants were interested in barefoot running to improve performance (Rothschild, 2012).

How are feet affected by barefoot activity?

Toughness of the foot

- One study showed that the heel is more resistant to pain than the thigh at the knee (Robbins, 1993).
- In this study, 12 healthy male volunteers had vertical and horizontal forces applied to two sites: the knee and the heel. The heel was selected because it is the area of the foot that is most sensitive to pain. Loads required to induce pain at the heel were greater than the loads to induce pain at the knee (Robbins, 1993).



How are feet affected by barefoot activity?

Foot strength & Flexibility

- Studies have shown that people who are habitually barefoot compared to habitually shod have stronger and stockier feet, and they experience less pressure on their feet while walking (Daout, 2009; Herje, 2017).
- Even regular barefoot activity strengthens the intrinsic musculature of the feet and shortens the foot arch including regularly dormant muscles of the foot (Robbins, 1987).
- A habitually barefoot Kenyan population had more flexible feet than habitually shod populations (Herje, 2017)





How are feet affected by barefoot activity?

Foot pathologies

- In a study of school-aged Kenyan children and adolescents, the habitually barefoot group reported lower injury prevalence than the habitually shod group (8% compared to 61%, $p=0.01$) (Herje, 2017).
- In a study of metatarsal bones, it was found that there were significantly more pathological lesions in modern shod feet than pre-pastor unshod metatarsal bones (Zipfel, 2007).



Injury in Running

Common Running injuries

- Posterior Tibial Tendonitis is a common running injury. A common symptom of this injury is pain on the medial longitudinal arch of the foot (Heidel, 2019).
- The condition can be improved through barefoot stretching and foot strengthening exercises (Heidel, 2019).
- Achilles tendinopathy (microtears in the Achilles tendon) is a running injury that may be caused by too much ankle plantarflexion and early/too much pronation (Tam, 2013).
- Patellofemoral pain, or knee pain, has been associated with weak glute strength and hamstring flexibility (Tam, 2013).



Injury in Running

Factors in running injuries

- Having a high-arch versus low-arch has no difference in injury prevalence. In a study with 20 high-arch and 20 low-arch participants, there were 70 injuries in the high-arch group and 64 injuries in the low-arch group (Williams, 2017).
- There were different injury patterns. The high-arch group showed more lateral injuries and low-arch group showed more medial injuries ($p=0.002$) (Williams, 2017).
- The high-arch group had more bony injuries while the low-arch group had more soft tissue injuries ($p=0.047$) (Williams, 2017).
- The low-arch group had more knee injuries, while the high-arch group had more foot/ankle injuries ($p=0.045$) (Williams, 2017).



Injury in Running

Factors in running injuries

- Running form can also affect running injuries
- Lower intensity running causes less impact on the body and produces a lower injury prevalence (Hreljac, 2004).
- There has been debate about the optimal amount of pronation for preventing running injuries. Pronation is the motion of the foot rolling inward while running, and its purpose is to absorb more impact from running (Hreljac, 2004).
- The best rate of pronation to reduce injury prevalence in running is a moderately rapid rate of pronation (Hreljac, 2004).
- Running with a rearfoot versus forefoot strike also has an impact on running injuries. Mild to moderate running injuries are 2.5 times more likely with a rearfoot strike than a forefoot strike (Altman, 2012).



Injury in Barefoot Running

Ground reaction forces

- Footwear has been shown to mitigate injury risk while jumping. During a drop vertical jump, there are lower ground reaction forces when wearing shoes than without shoes (Baha, 2021).
- While running, however, barefoot running is associated with reduced peak ground reaction forces compared to shod running (Hall, 2013).



Injury in Barefoot Running

Effects at the joints

- Barefoot running is associated with increased knee flexion at ground contact compared to neutral shoe running (Hall, 2013).
- Barefoot running is associated with increased foot and ankle plantarflexion at ground contact (Hall, 2013).



Injury in Barefoot Running

How is foot strike pattern affected by barefoot running?

- Barefoot running usually causes the runner to have a forefoot strike (Altman, 2012).
- The average loading rate and maximal loading rate during running are similar between shod and barefoot conditions, but loading rates are significantly higher when someone is heel striking compared to forefoot striking (Shih, 2013).
- Most habitually barefoot populations run with a midfoot or forefoot strike, but the Daasanach tribe of Kenya runs with a rearfoot strike. This tribe switches to a forefoot or midfoot strike at higher speeds. (Hatala, 2013).
- The difference between the Daasanach tribe and other African running tribes (Kalenjin tribe) is that the Daasanch live in an environment with softer ground and do not run as much, which could explain footstrike differences.



Injury in Barefoot Running

How does barefoot running affect running injuries?

- Barefoot running may help improve injuries
- In a survey of 509 people interested in barefoot running, 68% reported no new running injuries from barefoot, and 69% reported that old injuries went away from barefoot running (Hryvniak, 2014).
- When starting barefoot running, many things should be considered to avoid injury. A transitional plan should be studied, and the runner should do their research to fully understand barefoot running (Lieberman, 2012).



Injury in Barefoot Running

How does barefoot running affect running injuries?

- There are many factors in barefoot running that could affect injury rates. It could improve some injuries and aggravate others. Running barefoot improves some injury risk factors and makes others worse. (Tam, 2013).
- Barefoot running also improves proprioceptive feedback to the foot, which can help the body run more naturally and avoid injuries (Altman, 2012); (Goble, 2013).

Injury in Barefoot Running

How barefoot running affects biomechanical factors

Injury	Biomechanical factors associated with injury	Barefoot running effect	Theoretical implication
Stress fractures of tibia	↑ hip adduction, rearfoot eversion, ↑ Ground reaction force	↑ rearfoot eversion, ↓ Ground reaction force	Potential to reduce risk if ground reaction forces are lower
Patellofemoral pain	↑ eccentric load on knee, ↑ Rearfoot eversion, poor glute strength, inflexible hamstrings	↑ rearfoot eversion, ↓ Impact peak	May reduce forces experienced by knee
Achilles tendinopathy	↓ knee ROM, ↑ Ankle dorsiflexion at impact	↓ knee flexion at ground impact, ↑ Ankle plantarflexion	↑ risk from knee ROM changes but ↓ Risk through ankle changes



Application

Summary of risks and benefits

- Running barefoot makes the feet stronger and more flexible. It specifically strengthens the arch and intrinsic foot musculature
- Barefoot running forces runners to run with a forefoot strike, which is linked to lower injury prevalence
- Barefoot running gives the runner sensory feedback leading to lower ground reaction forces and a more natural form
- Running without shoes provides no protection from extreme temperatures or debris on the ground
- It is important to start barefoot running gradually, and to be informed and follow a proper training plan

Application

How does running experience affect response to barefoot running?

- Less trained runners will have a higher initial loading rate from barefoot running than more trained runners. More experience with running causes better transfer (Tam, 2017).
- Someone who just started running should not automatically transition to barefoot running





Application

Transitioning from shod to barefoot

- Transitioning from shod to barefoot should be practiced with caution to avoid injury (Altman, 2012).
- Make sure the body is prepared before starting barefoot running. Some exercises to do are single-leg balance, ankle flexibility, and exercises for strengthening intrinsic foot musculature before barefoot running (Rothschild, 2012b).
- Adaptation of plantar skin will take 3-4 weeks of 30 minute running (Rothschild, 2012b).



Application

Designing a plan to start barefoot running

- Runners should have a plan before starting barefoot running, be educated about barefoot running, and be experienced in running (Goble, 2013).
- Switching from shod to barefoot running initially causes a lower initial loading rate, but loading rate will eventually increase (Hollander, 2019).
- Transitioning to barefoot running should take 4-8 weeks at least. The runner should do exercises for hip and core stability, ankle ROM, intrinsic foot exercises. A general plan is to run a quarter mile to a mile every other day for the first week. After that, barefoot running mileage should not be increased by more than 10% each week (Rothschild, 2012b).

Application

Is running in minimalist shoes a suitable alternative?

- Minimalist running shoes could be a great alternative to running barefoot
- Minimalist running shoes will help someone reap benefits of barefoot running while avoiding surface hazards and frostbite (Krabak, 2011; Goble, 2013).





References

Aibast, H., Okutoyi, P., Sigei, T., Adero, W., Chemjor, D., Ongaro, N., Pitsiladis, Y. (2017). Foot structure and function in habitually barefoot and shod adolescents in Kenya. *Current sports medicine reports*, 16(6), 448-458.

Altman, A. R., Davis, I. S. (2012). Barefoot running: biomechanics and implications for running injuries. *Current sports medicine reports*, 11(5), 244-250.

Baha, P., Andrusiak, J., Dickey, J., Getgood, A. M., Burkhart, T. A. (2021). Biomechanical differences between shod and barefoot jumping and landing tasks: 531. *Medicine & Science in Sports & Exercise*, 53(8S), 176-177.

Bramble, D.M., Lieberman, D.E. (2004). Endurance running and the evolution of Homo. *Nature*, 432(7015), 345-52. doi: 10.1038/nature03052.

D'Août, K., Pataky, T.C., De Clercq, D., Aerts, P. (2009). The effects of habitual footwear use: foot shape and function in native barefoot walkers. *Footwear Science*, 1(2), 81-94.

Goble, C., Wegler, J., Forest, C. P. (2013). The potential hazards of barefoot running: proceed with caution. *Journal of the American Academy of PAs*, 26(3), 49-53.

Hall, J.P., Barton, C., Jones, P.R., Morrissey, D. (2013). The biomechanical differences between barefoot and shod distance running: a systematic review and preliminary meta-analysis. *Sports Med*, 43(12), 1335-53. doi: 10.1007/s40279-013-0084-3.

Hatala, K.G., Dingwall, H.L., Wunderlich, R.E., Richmond, B.G. (2013). Variation in foot strike patterns during running among habitually barefoot populations. *PLoS One*, 8(1). doi: 10.1371/journal.pone.0052548.

Heindel, M., Buchanan, K. (2018). Barefoot rehabilitation of type II posterior tibialis tendon dysfunction in a veteran: a case report. *Medicine and Science in Sports and Exercise*, 51(6).

Hollander, K., Liebl, D., Meining, S., Mattes, K., Willwacher, S., Zech, A. (2019). Adaptation of running biomechanics to repeated barefoot running: a randomized controlled study. *The American Journal of Sports Medicine*, 47(8), 1975-1983.



References

Hreljac, A. (2004). Impact and overuse injuries in runners. *Med Sci Sports Exerc*, 36(5), 845-9. doi: 10.1249/01.mss.0000126803.66636.dd

Hryvniak, D., Dicharry, J., Wilder, R. (2014). Barefoot running survey: evidence from the field. *Journal of Sport and Health Science*, 3(2), 131-136.

Krabak, B. J., Hoffman, M. D., Millet, G. Y., Chimes, G. P. (2011). Barefoot running. *PM&R*, 3(12), 1142-1149.

Lieberman, D.E. (2012). What we can learn about running from barefoot running: an evolutionary medical perspective. *Exerc Sport Sci Rev*, 40(2), 63-72. doi: 10.1097/JES.0b013e31824ab210.

Shih, Y., Lin, K. L., Shiang, T. Y. (2013). Is the foot striking pattern more important than barefoot or shod conditions in running? *Gait & posture*, 38(3), 490-494.

Tam, N., Wilson, J. L. A., Noakes, T. D., Tucker, R. (2014). Barefoot running: an evaluation of current hypothesis, future research and clinical applications. *British journal of sports medicine*, 48(5), 349-355.

Tam, N., Coetzee, D. R., Ahmed, S., Lamberts, R. P., Albertus-Kajee, Y., Tucker, R. (2017). Acute fatigue negatively affects risk factors for injury in trained but not well-trained habitually shod runners when running barefoot. *European journal of sport science*, 17(9), 1220-1229.



References

Robbins, S. E., Hanna, A. M. (1987). Running-related injury prevention through barefoot adaptations. *Med Sci Sports Exerc*, 19(2), 148-156.

Robbins, S., Gouw, G. J., McClaran, J., & Waked, E. (1993). Protective sensation of the plantar aspect of the foot. *Foot & ankle*, 14(6), 347-352.

Rothschild, C. E. (2012). Primitive running: a survey analysis of runners' interest, participation, and implementation. *The Journal of Strength & Conditioning Research*, 26(8), 2021-2026.

Rothschild, C. (2012). Running barefoot or in minimalist shoes: evidence or conjecture? *Strength & Conditioning Journal*, 34(2), 8-17.

Williams III, D. S., McClay, I. S., Hamill, J. (2001). Arch structure and injury patterns in runners. *Clinical biomechanics*, 16(4), 341-347.

Zipfel, B., Berger, L.R. (2007). Shod versus unshod: the emergence of forefoot pathology in modern humans? *The Foot*, 17(4), 205-213. <https://doi.org/10.1016/j.foot.2007.06.002>.

https://www.runtastic.com/blog/wp-content/uploads/2020/07/blog_thumbnail_trail-running-tips_1200x800-1-1024x683.jpg