

## **Abstract**

**Title:** Comparison of kinematic and dynamic characteristics of the running stride in barefoot running, minimalist shoes, spiked shoes and running shoes

**Objectives:** The goal of this study is to determine how selected kinematic and dynamic characteristics of the running stride change with different types of footwear (shoes, spiked shoes, minimalist shoes) or when running barefoot.

**Methods:** The measurements were conducted on 21 participants (active athletes competing in athletic disciplines for at least four years, capable of running in track spikes). A biomechanical analysis was performed using dynamometric plates and the Optojump Next optical device. The research was conducted on a long jump runway at the Faculty of Physical Education and Sport of Charles University, with each participant running a prepared 30-meter track 8-10 times at 80 % of their maximum speed. Statistical analysis was performed using the magnitude-based inference method.

**Results:** Step frequency increased when running barefoot (shoes:  $3.89 \pm 0.23$  steps/s, minimalist shoes:  $3.90 \pm 0.18$  steps/s, track spikes:  $3.91 \pm 0.21$  steps/s, barefoot:  $3.94 \pm 0.22$  steps/s), step length shortened when running barefoot (shoes:  $199.3 \pm 7.5$  cm, minimalist shoes:  $200.1 \pm 6.3$  cm, track spikes:  $199.7 \pm 6.8$  cm, barefoot:  $198.8 \pm 6.7$  cm), and the flight phase duration also shortened when running barefoot (shoes:  $0.128 \pm 0.011$  s, minimalist shoes:  $0.128 \pm 0.009$  s, track spikes:  $0.128 \pm 0.010$  s, barefoot:  $0.125 \pm 0.009$  s) compared to other footwear conditions. Additionally, impact force was compared (shoes:  $2977 \pm 623$  N, minimalist shoes:  $3004 \pm 746$  N, barefoot:  $3603 \pm 959$  N).

**Conclusion:** Running barefoot is significantly different in most observed factors. Running in minimalist shoes cannot be considered as "protected" barefoot running, as the measured factors are more similar to running in shoes.

**Keywords:** footstrike pattern, impact force, change in horizontal velocity, change in vertical velocity, flight phase, support phase, braking phase, propulsion phase, step length, barefoot running, track spikes, minimalist shoes, running shoes, Optojump, Kistler dynamometric plates.