

Acute physiological, biomechanical, and perceptual responses of runners wearing downward-curved carbon fiber insoles

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Abstract

In a randomized controlled cross-over study ten male runners (26.7 ± 4.9 years; recent 5-km time: $18:37 \pm 1:07$ min:s) performed an incremental treadmill test (ITT) and a 3-km time trial (3-km TT) on a treadmill while wearing either carbon fiber insoles with downwards curvature or insoles made of butyl rubber (control condition) in light road racing shoes (Saucony Fastwitch 9). Oxygen uptake, respiratory exchange ratio, heart rate, blood lactate concentration, stride frequency, stride length and time to exhaustion were assessed during ITT. After ITT, all runners rated their perceived exertion, perceived shoe comfort and perceived shoe performance. Running time, heart rate, blood lactate levels, stride frequency and stride length were recorded during, and shoe comfort and shoe performance after, the 3-km TT. All parameters obtained during or after the ITT did not differ between the two conditions [range: $p = 0.188$ to 0.948 (alpha value: 0.05); Cohen's $d = 0.021$ to 0.479] despite the rating of shoe comfort showing better scores for the control insoles ($p = 0.001$; $d = -1.646$). All parameters during and after the 3-km TT showed no differences ($p = 0.200$ to 1.000 ; $d = 0.000$ to 0.501) between both conditions except for shoe comfort showing better scores for control insoles ($p = 0.017$; $d = -0.919$). Running with carbon fiber insoles with downwards curvature did not change running performance or any submaximal or maximal physiological or biomechanical parameter and perceived exertion compared to control condition. Shoe comfort is impaired while running with carbon fiber insoles. Wearing carbon fiber insoles with downwards curvature during treadmill running is not beneficial when compared to running with control insoles.

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**Reference: Ethical Approval Statement of the Ethical Review Board of the Master Program Exercise
Science and Training**

The ethical review board herewith confirms the ethical approval to the application of PD Dr. Florian
Engel and allocates the following number to the ethical approval:

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