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Case Study of Record-Breaking Ironman Athlete in Response to Cushioned Footwear and Fatigue States

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INTRODUCTION:
Technological advancements in footwear have gained increasing attention due to their performance benefits particularly on the road racing marathon distance [1]. Focusing on the cushioning element of these shoes, previous research has found that softer midsoles improve running economy [2]. Other than road runners, Ironman athletes also use such footwear during the marathon leg of a race but start in a more fatigued state. Previous research has found that alterations in running kinematics with worse running economy have been linked to fatigue in prolonged running [3]. Interestingly it has also been found that despite being in a muscle damaged state, highly cushioned shoes continue to improve running performance [4]. Knowing this, the aim of this study was to investigate if fatigue levels alter the running economy response in a world-class Ironman athlete to different shoe conditions.
METHODS:
This case study included one world-class Ironman athlete (age: 36 years; weight: 65.8 kg; height: 178 cm) who 3 weeks prior had broken the Ironman run course record with the fastest marathon time of 2:30:32 (h:min:sec) during an Ironman competition. We conducted submaximal laboratory-based assessments during two different sessions. The first testing session included steady state running economy trials at the average marathon pace (17 km/h) of his most recent Ironman race in two different shoe conditions in a randomized counterbalanced repetitive order. The second session consisted of a similar protocol but was conducted with each steady-state trial following a 15-minute race level (260 W) biking leg. The shoe conditions included an advanced footwear technology shoe consisting of a curved stiff element in the forefoot and a 40 mm high stack height of a lightweight resilient foam, as well as a maximal shoe, with matching technology but with an even higher stack height of 50 mm. These shoes differ particularly in terms of their cushioning properties with the maximal shoe having 9.0% (1.6 mm) more maximal deformation under 2000 N of force as measured on a material testing machine.
RESULTS:
At average marathon speed, in a non-fatigued state, the advanced footwear technology condition (55.6 mL/kg/min) was more efficient than the maximal shoe (56.3 mL/kg/min). Testing in a fatigued state revealed an opposing trend with the maximal shoe (55.1 mL/kg/min) being more efficient than the advanced technology condition (56.9 mL/kg/min).
CONCLUSION:
While this is a single case study example, for this Ironman triathlete, when adding the fatigue from the bike leg, the increased deformation of the maximal shoe benefits the efficiency of this runner by 3.2% whereas in a non-fatigued state this athlete does not appear to benefit from the additional stack height.
REFERENCES:
1. Muniz-Pardos et al., Sports Med, 2021
2. Worobets et al., Footwear Sci, 2014
3. Burgess et al., Int J Sports Med, 2012
4. Black et al., Med Sci Sports Exerc, 2022

Topic: **Sport Technology**

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