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Eight weeks gait retraining in minimalist footwear has no effect on running economy



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ABSTRACT

Purpose: To evaluate the effects of an eight week combined minimalist footwear (MFW) and gait-retraining intervention on running economy (RE) and kinematics in conventional footwear runners.

Methods: Twenty-three trained male runners (age: 43 ± 10 years, stature: 177.2 ± 9.2 cm, body mass: 72.8 ± 10.2 kg, $\dot{V}O_{2\max}$: 56.5 ± 7.0 mL min^{-1} kg^{-1}) were recruited. Participants were assigned to either an intervention group ($n = 13$) who gradually increased exposure to MFW and also implemented gait-retraining over an eight week period. RE and kinematics were measured in both MFW and conventional running shoes (CRS) at pre-tests and eight weeks, in a random order. In contrast the control group ($n = 10$) had no MFW exposure or gait retraining and were only tested in CRS.

Results: The MFW and gait re-training intervention had no effect on RE ($p < .001$). However, RE was significantly better in MFW (mean difference 2.72%; $p = .002$) at both pre and post-tests compared to CRS. Step frequency increased as a result of the intervention (+5.7 steps per minute [spm]; $p < .001$), and was also significantly higher in MFW vs. CRS (+7.5 spm; $p < .001$).

Conclusion: Whilst a better RE in MFW was observed when compared to CRS due to shoe mass, familiarization to MFW with gait-retraining was not found to influence RE.

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Recent scientific interest in barefoot and minimalist running has resulted in an increasing body of research in this area in relation to running performance (e.g. Divert et al., 2008; Hanson, Berg, Deka, Meendering, & Ryan, 2011; Perl, Daoud, & Lieberman, 2012; Squadrone & Gallozzi, 2009; Warne & Warrington, 2013). In a homogenous group of runners, running economy (RE) has been considered a strong predictor of endurance performance (Lucia, Esteve-Lanao, Oliven, Gomez-Gallego, & Foster, 2006). With regard to footwear, several studies have reported significant differences in RE between barefoot or minimalist footwear when compared to conventional footwear (Divert et al., 2008; Lussiana, Fabre, Hébert-Losier, & Mourot, 2013; Perl et al., 2012; Squadrone & Gallozzi, 2009; Warne & Warrington, 2013) and so it appears that changing footwear may be a means to influence performance.

Despite these reported improvements in RE, only limited research has investigated the process and effects of the footwear transition in athletes when moving from habitual conventional running shoe wear into minimalist or barefoot running, as this is now a popular trend among runners (Rothschild, 2012). Rather, the findings of the majority of studies are based on results from acute interventions or using previously habituated barefoot or minimalist runners (Divert et al., 2008; Hanson et al., 2011; Lussiana et al., 2013; Perl et al., 2012; Squadrone & Gallozzi, 2009). Recently published data by our research group observed significant improvements in running economy (8.09%) following a four week familiarization to minimalist footwear (MFW) with no gait-retraining, when compared with conventional running shoes (CRS) (Warne & Warrington, 2013). This study did not include any suggestions for changes in the running gait, but recently some authors have recommended the use of a barefoot running style (gait retraining) in light of purported benefits to RE and a reduction in injury risk (Goss & Gross, 2013; Jenkins & Cauthon, 2011), largely in combination with the use of MFW, but also just in CRS (Goss & Gross, 2013). Gait retraining has now become a popular intervention for runners (Dallam, Wilber, Jadelis, Fletcher, & Romanov, 2005; Fletcher, Bartlett, Romanov, & Futouhi, 2008; Goss & Gross, 2013) and manufacturers (www.merell.com), although long term prospective studies are still required. This gait retraining proposes increasing step frequency and adopting a mid or forefoot strike (Fletcher et al., 2008; Goss & Gross, 2013), but these factors examined individually or in combination have been found to have no effect on RE (Ardigo, Lafortuna, Minetti, Mognoni, & Saibene, 1995; Fletcher et al., 2008; Gruber, Umberger, Braun, & Hamill, 2013). To date, there are no reported studies that have examined if the use of both a gait retraining intervention and MFW transition can influence RE.

The aims of the present study were therefore twofold; (1) to determine the effects of a combined eight week MFW and gait-retraining intervention on RE and simple kinematic changes (step frequency and foot strike patterns) in both MFW and CRS when compared to a control group in CRS with no intervention; (2) to examine if differences exist in RE and kinematics between MFW and CRS, both before and after exposure to the MFW and gait retraining intervention. Within these aims, we adopted both a within-group control (the CRS condition) as well as a between-group control (the control group) to examine these factors. Based on our previous findings (Warne & Warrington, 2013), we hypothesized that the MFW and gait-retraining intervention would improve RE in the MFW condition.

1. Methods

1.1. Participants

Twenty-three moderately trained male runners (age: 43 ± 10 years, stature: 177.2 ± 9.2 cm, body mass: 72.8 ± 10.2 kg, $\dot{V}O_{2\max}$: 56.54 ± 6.97 mL min^{-1} kg^{-1}) were recruited from local athletic clubs. Participants typically ran 4–6 days per week with a mean weekly running distance of 52 (± 10) km at the time of the study. Participants were excluded if they had reported any running related injuries in the last three months, or had previous barefoot or minimalist running experience. Only male athletes were used to eliminate gender differences in running mechanics (Ferber, Irene, & Dorsey, 2003). All participants had previous experience with treadmill running. The participants gave informed

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