Effect of Treadmill Surface Stiffness on the Running Economy Benefits of a Highly-Cushioned Racing Shoe: A Pilot Study

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ABSTRACT

Running economy (RE) is defined as the oxygen consumption (VO_2) at a given running speed. The Nike Vaporfly line of racing shoes, which includes more compliant and resilient midsole foam and a carbon-fiber plate, have been shown to improve RE during treadmill testing. Previous research suggests that RE in general is worse on treadmills with stiffer running platforms. However, it is unclear if the magnitude of the RE benefits provided by these new shoes relative to a control shoe differ based on treadmill stiffness. Given that some treadmill platforms allow more flex or compliance, this may be an important consideration when comparing the effects of new footwear. Placing shims under the spans of a treadmill can increase surface stiffness and allow for such comparisons. **PURPOSE**: Determine the RE benefits of the Nike Vaporfly NEXT% 2 (VFN2) racing shoe relative to a mass-matched control (CTRL) shoe, under shimmed (SHIM) and non-shimmed (NON) treadmill conditions. **METHODS**: Four male runners (23 ± 8 years, 176 ± 4 cm, 61.8 ± 8.6 kg) completed 8 x 5-minute trials at 12 km·hr^{-1} on a level, motorized treadmill (Cardiac Science TM 55) with a 5-minute rest between trials. Both the VNF2 and CTRL shoe were tested twice under both the SHIM and NON treadmill conditions. The Asics Hyper Speed was used as the CTRL shoe given its traditional midsole foam and absence of a carbon-fiber plate. Approximately 16 g was added to VFN2 to mass-match the CTRL shoe. For the SHIM trials, an adjustable screw jack was elevated under both sides of the treadmill spans near the location of foot strike. VO_2 was measured continuously throughout each trial and averages from the final 2-minutes for each of the two trials for a given shoe-treadmill condition were determined. **RESULTS**: VFN2 improved RE to a similar extent relative to CTRL for NON (1.2 ± 0.7%; p = 0.041) and for SHIM (1.1 ± 0.43%; p = 0.013) treadmill conditions. The average difference (NON minus SHIM) in the % energy savings conferred by the VFN2 was only 0.08 ± 0.29%. VO_2 (ml·kg^{-1}·min^{-1}) is provided for each subject based on shoe-treadmill condition with % reductions in VO_2 for VFN2 relative to CTRL displayed for each treadmill condition.
Subject A: CTRL-NON 36.68, VFN2-NON 36.16; 1.41%; CTRL-SHIM 37.02, VFN2-SHIM 36.50; 1.40%.
Subject B: CTRL-NON 37.98, VFN2-NON 37.22; 2.02%; CTRL-SHIM 37.45, VFN2-SHIM 36.88; 1.53%.
Subject C: CTRL-NON 37.26, VFN2-NON 36.90; 0.98%; CTRL-SHIM 37.86, VFN2-SHIM 37.49; 0.98%.
Subject D: CTRL-NON 38.41, VFN2-NON 38.26; 0.39%; CTRL-SHIM 38.43, VFN2-SHIM 38.21; 0.57%.
Independent of shoe condition, SHIM resulted in worse RE for subject A and C, improved RE for subject B, and left RE unchanged for subject D. **CONCLUSION**: Shimming the span of the Cardiac Science TM 55 treadmill to increase surface stiffness may negatively impact RE overall for some individuals. However, this does not appear to impact the benefits provided by the VFN2 relative to a CTRL shoe at the 12 km·hr^{-1} speed tested in this pilot study.