hiking poles during ultra-marathon trail running

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Introduction

Endurance events have increased in popularity over the past 30 years and the number of new ultra-endurance events becoming available each year continues to multiply. Bridel, Markula and Denison (2015, Endurance running: A socio-cultural examination. Oxford: Routledge) defined ultra-running as any distance greater that a standard marathon (26.2 miles or 42.3 km). A trail ultra-marathon mainly consists of country and woodland paths, mountain trails and can include very uneven, rocky or muddy ground. Millet, Hoffman and Morin (2012, *Journal of Applied Physiology*, 113(3), 507-509) reported that despite the increased cost of running (CR) attributed to pole use; the practice was common during trail ultra-marathon running. It has been suggested, that the improved balance and the shifting of load from the lower limbs to the upper body facilitated by poles, could enhance performance (Millet et al., 2012).

Purpose

To investigate physiological responses whilst running over typical trail ultra-marathon terrain under two experimental conditions; with and without hiking poles.

Method

The institutional ethics committee approved the study. Eight experienced, fit and healthy endurance runners (mean + s.d.; age = 37.8 ± 6.8 years) completed one warm-up and three recorded laps of a 3.2 km outdoor course designed to be representative of a trail ultra-marathon. The course (figure 1) included a steep ascent (average 11%, max 17%) and descent (average -9.5%, max -15%) and was traversed at a fixed average speed of 2.67 m·s^{-1} (Daviaux, Hintzy, Samozino & Hughson, 2013, European Journal of Sport Science, 13(5), 468-474). Oxygen uptake (VO_2), heart rate (HR), blood lactate (BLa) and delayed onset of muscle soreness (DOMS) were measured and the variables compared for the two experimental conditions completed by participants in a randomised order, 7-days apart.

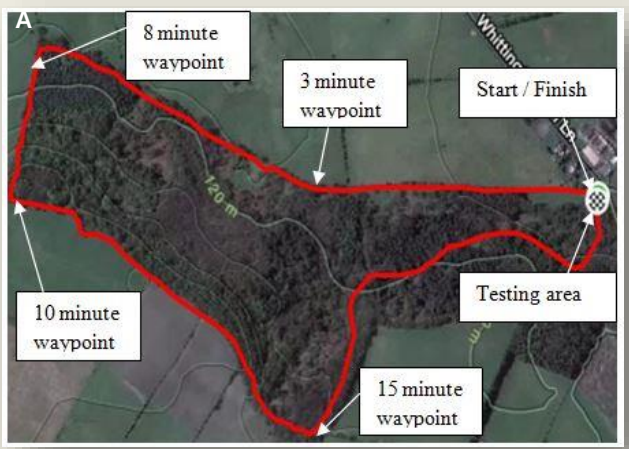

Figure 1:
(A) Overhead view of 3.2 km course marked with timing waypoints, start / finish line and testing area.
(B) Profile of 3.2 km course showing elevation and gradient.

Data Analysis

A one-tailed paired t-test compared VO_2, HR, BLa and DOMS between the conditions and a one-way ANOVA with pairwise post-hoc Bonferroni correction checked for any lap effect.

Results

The main findings from this study were that average energy usage increased significantly ($p < 0.0001$) when running with poles when opposed to the non-pole condition; an increase of 7.4%. This however reduced to 4.3% during steep uphill locomotion (figure 2).

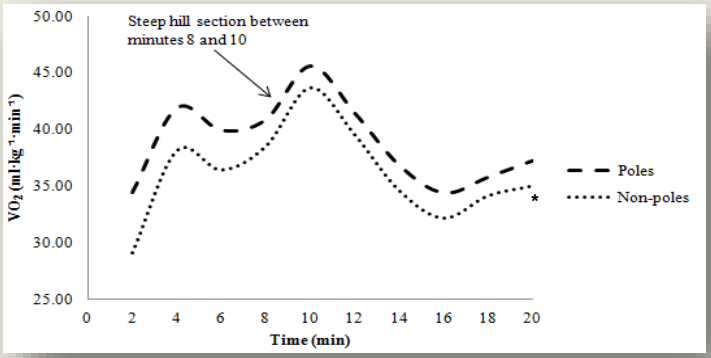

Figure 2: Comparison of VO_2 by condition, highlighting the narrowing of energy usage during the steep uphill section between minutes 8 and 10.

The post-test measurements showed a significant reduction in the measurement of DOMS ($p = 0.002$), indicating that the use of poles could reduce muscle damage (figure 3).

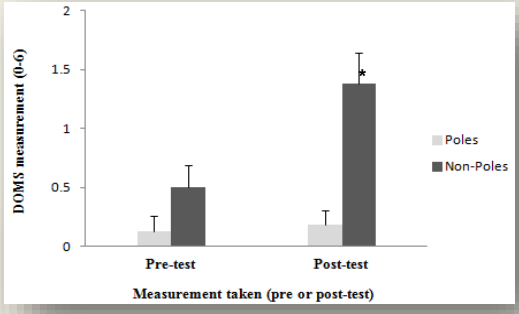

Figure 3: DOMS measures (scale of 0-6) pre and post test with SE (* $p = 0.002$).

Conclusion

The current study supports the hypothesis that pole use increases CR and that the difference between the two conditions is reduced when traversing steep hills. However, the increase in CR does appear to be offset by a reduction in self-perceived muscle damage. The present findings suggest that pole use could improve performance during trail ultra-marathons by reducing muscle damage and thus increasing the length of time that %VO_{2max} could be maintained.