CAN A RUNNER'S ECONOMY AND ARM MOTION BE AFFECTED BY FEEDBACK TRAINING?

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INTRODUCTION

It has been shown that among runners with similar VO_{2max} a runner with higher running economy will perform better than one with lower running economy [1]. Several biomechanical variables have been related to running economy [2, 3, 4]. The coaching literature suggests that arm swing is important for "efficient" running. It has been suggested that training with a harness to modify arm swing can improve running economy [5]. The purpose of this research was to determine: 1) if initial reaction (first day of use) to an arm harness affects running economy and arm mechanics; and 2) if a training period with an arm harness improves running economy and arm mechanics.

METHODS

Initial Reaction Study: Eighteen runners (male and female) volunteered to participate. Each subject ran less than 20 miles per week. Running economy, wrist excursion, superior-inferior (S-I) distance from the wrist to the jugular notch, and medio-lateral (M-L) distance from the wrist to the jugular notch were measured while running with and without a harness to modify arm swing [5].

Harness Training Study: Thirteen subjects who exhibited excessive crossover (M-L distance from the wrist to jugular notch $\leq$ 9.6 cm) or excessively low arm carriage (S-I distance from the wrist to jugular notch $\geq$ 39.8 cm) trained with the harness. A within subject design was used in which running economy, wrist excursion, S-I distance, and M-L distance were measured prior to training (Test), after 3 weeks of no harness training (Mid Test) and after 3 weeks of harness training (Post Test).

Dependant Variables: Running economy was defined as speed divided by VO2submax (mi*kg/ml). VO2submax was averaged over the last 5 minutes of a 10-minute run. Two video cameras recorded the spatial position of reflective markers at the ulnar stylus and jugular notch. Wrist excursion was defined as the total three-dimensional distance traveled by the wrist in one arm swing. All kinematic variables were averaged over 6 consecutive strides.

Statistical Analysis: One-way repeated measures ANOVA's with a significance level of $p \leq .05$ was used to determine if there was an improvement in running economy, wrist excursion, S-I distance and M-L distance.

RESULTS AND DISCUSSION

Wrist excursion and S-I distance were the only dependant variables that improved for both the initial reaction study (Table 1) and after training with the harness (Table 2). M-L distance did not improve in either study. Also, running economy did not improve despite a change in mechanics. One might suspect that the training period was not long enough; however, Messier et al. reported similar results; 5 weeks of technique training also saw an improvement in running mechanics and not in running economy [6].

Hinrichs reported that arm crossover was necessary to counteract the angular momentum of the legs about the vertical axis while running [7]. Egbuonu et al. reported that restricted arm movement decreased running economy [8]. Since arm crossover was not reduced in our study, angular momentum about the vertical axis was not likely affected and therefore, running economy was unchanged. The arm harness was ineffective for reducing arm crossover and had minimal effect on running economy.

REFERENCES

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Table 1: Results for the initial reaction study reported as mean ± std. dev. (except Wrist Excursion is reported as the median).

	RE (mi*kg/ml)	**Wrist Exc.** (cm)	**S-I** (cm)	**M-L** (cm)
No Harness	$3.34 \times 10^{-3} \pm 0.32 \times 10^{-3}$	93.7*	$38.3 \pm 7.3^{\#}$	10.7 ± 4.2
Harness	$3.41 \times 10^{-3} \pm 0.40 \times 10^{-3}$	76.7*	$28.4 \pm 4.9^{\#}$	11.6 ± 3.4

Table 2: Results for the harness training study reported as mean ± std. dev.

	RE (mi*kg/ml)	**Wrist Exc.** (cm)	**S-I** (cm)	**M-L** (cm)
Test	$3.37 \times 10^{-3} \pm 0.32 \times 10^{-3}$	$97.0 \pm 16.6^{\#}$	$40.6 \pm 6.8^{+}$	10.7 ± 4.9
Mid Test	$3.50 \times 10^{-3} \pm 0.35 \times 10^{-3}$	$95.6 \pm 17.0^{!}$	39.5 ± 6.6	10.9 ± 4.6
Post Test	$3.48 \times 10^{-3} \pm 0.27 \times 10^{-3}$	$87.7 \pm 14.7^{\#!}$	$37.0 \pm 5.0^{+}$	11.9 ± 4.7