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Measuring Physiological Changes in Response to a Division III Collegiate Cross-Country Season

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Introduction

- The goal of cross-country training regimens is to maximize oxygen consumption, increase metabolic efficiency of skeletal muscle, and delay the onset of fatigue. [1]
- Performance can be predicted from variables such as maximal oxygen uptake ($VO_{2\ Max}$), lactate threshold (LT), and running economy (RE). [3,4]
- $VO_{2\ Max}$ measures oxygen consumption and it represents a maximal aerobic capacity. [3,4]
- LT is the point at which blood lactate accumulates. [3,4,5]
- RE reflects the energy demand for a given velocity of running and reflects overall running efficiency. [5,6]
- After a cross-country season, we expect to see an increase in $VO_{2\ Max,}$ increased LT, and an improved RE to indicate efficacy of a training program. [2]
- Ideally, successful training programs include high mileage with a variation of long runs, interval training at or below race pace, and moderate sprint work. [5]

Purpose

To assess how physiological variables change over a competitive cross-country season in Division III female athletes.

Materials and Methods

Subjects

- 11 female Division III cross-country athletes (20.18 ±1.25 years, 162.89 ±7.46 cm, 58.22 ±8.91 kg, 21.5 ±1.65 % body fat) were recruited to participate.

Procedure

- Subjects came to the lab on two occasions 10-12 weeks apart, pre and post season, and followed an identical procedure:
  - Height, weight, and body composition measurements were taken.
  - Three trials of a maximal vertical jump were performed.
  - A 3 minute treadmill warm up was completed.
  - A staged $VO_{2\ Max}$ treadmill test was performed, with the grade increasing 2% every three minutes at a steady pace between 6.5-7.5 mph.
  - Blood lactate, VO_2, heart rate, and RPE readings were taken every 3 minutes.
  - After a rest period, a RE treadmill test was completed by measuring oxygen consumption while running 4 minutes at a 'steady' pace and 4 minutes at a 'race' pace.
- Performance was analyzed by comparing average seconds per mile in the first and last race of the season.

Data Analysis

- Paired-samples *t*-tests were used to compare the pre and post season physiological data.

Results

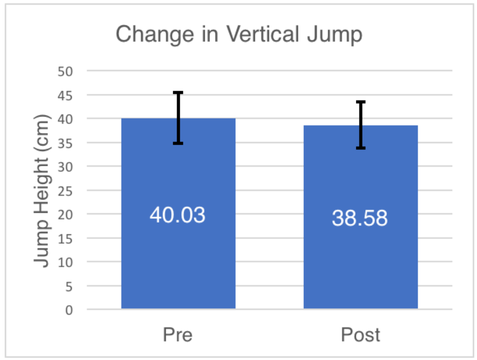


Figure 1. Mean vertical jump (cm) pre and post season.

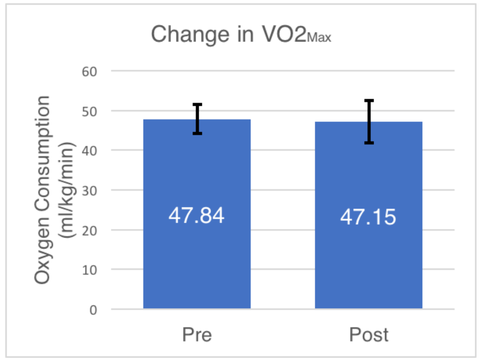


Figure 2. Mean $VO2_{Max}$ (ml/kg/min) pre and post season.

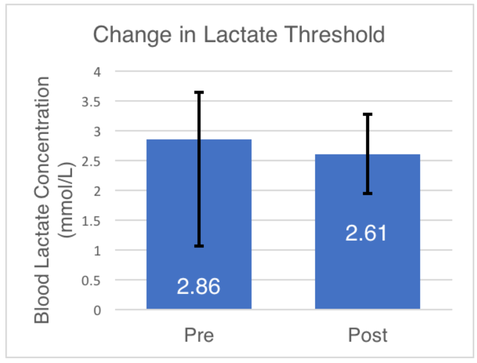


Figure 3. Mean lactate threshold (mmol/L) pre and post season.

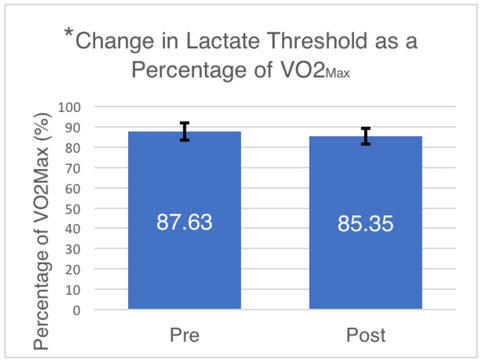


Figure 4. Mean lactate threshold as a percentage of $VO2_{Max}$ pre and post season.
* indicates $p < 0.05$.

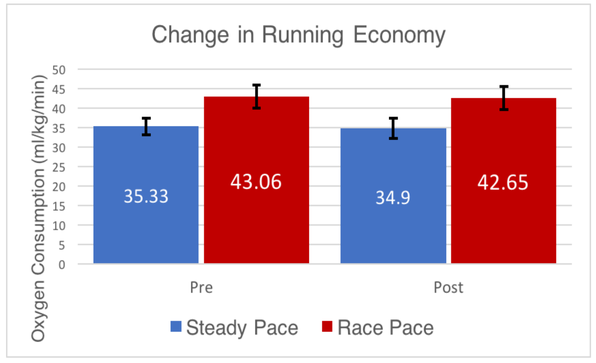


Figure 5. Mean running economy (ml/kg/min) at a slow, steady pace and a faster, race pace pre and post season.

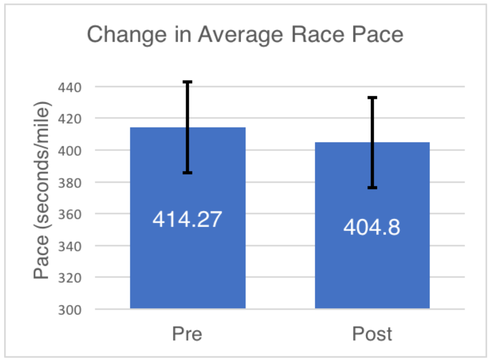


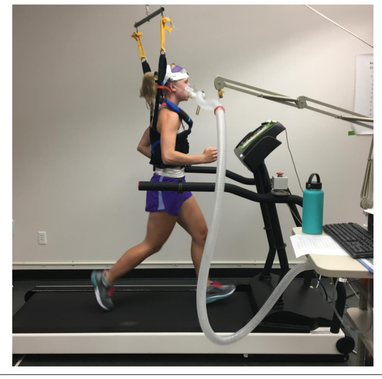
Figure 6. Mean race pace (seconds/mile) pre and post season.

Discussion

- The principle of Specific Adaptations to Imposed Demands (SAID) indicates a training program which transitions from high mileage and moderate intensity to lower mileage and high intensity is designed to increase the demand placed on the anaerobic system. [1,5]
- An increase in anaerobic capacity is consistent with a decrease in LT along with a significant decrease in LT as a percentage of $VO_{2\ Max.}$ [3]
- No significant changes observed in vertical jump, $VO_{2\ Max,}$ or RE are consistent with previous research among trained distance runners over the course of a cross-country season. [2,6,]
- Despite a lack of a statistically significant difference in average seconds per mile, an increase of 10 seconds per mile is considerable across a 3.75 mile race. [5]
- At the start of the competitive season, athletes were already well trained, likely accounting for the lack of significant changes. [2,6]
- Beneficial future research could include a variable of anaerobic capacity such as a Wingate test. [2,4]

Conclusion

A 10-12 week collegiate cross-country season does not significantly influence physiological variables likely due to the training demands which stressed the anaerobic system and therefore lead to specific adaptations in the anaerobic system.



Literature Cited

1. Brooks, G. A., Fahey, T. D., & Baldwin, K. M. (2005). *Exercise Physiology: Human bioenergetics and its applications.* New York, NY: The McGraw-Hill Companies.
2. Baumann, C. W., & Wetter, T. J. (2010). Aerobic and anaerobic changes in collegiate male runners across a cross-country season. *International Journal of Exercise Science*, *3*(4), 225-232.
3. Ghosh, A. K. (2004). Anaerobic threshold: its concept and role in endurance sport. *Malaysian Journal of Medical Sciences*, *11*(1), 24-36.
4. Jacobs, R. A., Rasmussen, P., Siebenmann, C., Díaz, V., Gassmann, M., Pesta, D., . . . Lundby, C. (2011). Determinants of time trial performance and maximal incremental exercise in highly trained endurance athletes. *Journal of Applied Physiology*, 111, 1422-1430.
5. Magness, S. (2014). *The science of running.* Lexington, KY: Origin Press.
6. Saunders, P. L., Pyne, D. B., Telford, R. D., & Hawley, J. A. (2004). Factors affecting running economy in trained distance runners. *Sports Medicine*, *34*(7), 465-485.