Effect of Aerobic Capacity on Sprint Performance in College Football Linemen

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BACKGROUND AND PURPOSE

- High aerobic capacity promotes efficient recovery from the physiologic effects of repeated anaerobic exertions[1]
  - Repeated sprints are a common form of football conditioning believed to improve game performance
- Phosphocreatine is the sole energy source for the initial 10 seconds of a sprint[1]
  - Aerobic sources account for ~20% of the energy utilized during a subsequent sprint without recovery time[2]
  - A VO_2Max threshold for anaerobic performance benefit has been theorized to exist for each individual athlete[3]
- The extent of aerobic compensation for depleted anaerobic energy during repeated high-power tasks is unknown[4]
  - There is evidence that post-sprint phosphocreatine level is positively influenced by aerobic metabolism
- The purpose of this study was to compare decline in repeated anaerobic sprint performance between football players with high versus low aerobic capacity

PARTICIPANTS AND PROCEDURES

- 16 male NCAA Division-I FCS Football Linemen; 10 Offensive; 6 Defensive
  - Age (20.6 yrs ±1.4); Height (188.43 cm ±3.99); Mass (126.3 kg ±9.2); BMI (35.59 kg/m^2 ±2.82)
- Athletes were fully participating in all preseason football conditioning activities at the time of testing
  - Only "interior" defensive linemen were included because of much larger body mass than defensive ends
- Resting heart rate (HRrest) was recorded before testing began (Timex® pulse monitor, Middlebury, CT)
- 3 baseline 20-yd sprints were timed by an opto-electric system (Brower® Timing System, Draper, UT)
- A graded treadmill test was administered, which was terminated by fatigue (i.e., inability to maintain pace)
  - Treadmill was initially set to 4 mph with a 6% grade, which was increased 1 mph and 2% every 3 minutes
  - Maximal heart rate (HRmax) was recorded immediately upon termination of the treadmill test
- VO_2Max was estimated using the Uth-Sørensen-Overgaard-Pedersen equation: $VO_2Max = 15 * (HRmax/HRrest)$
- 3 "fatigued" 20-yd sprints were performed very shortly after termination of the treadmill test (i.e., within ~15-30 s)
- Baseline trial and fatigued trial (average of 3 sprints each) were compared to quantify performance decrement
- Cases dichotomized on the basis of published VO_2Max standard,[5] data analyzed by 2x2 cross tabulation
  - Receiver operating characteristic (ROC) analysis used to dichotomize sprint performance decrement

RESULTS

- VO_2Max was associated with magnitude of average change in sprint time from baseline to post-fatigue (Figure 1)
  - VO_2Max mean =37.9 ±4.6 mL/kg/min (Figure 2); Sprint time decrement mean =0.06 ±0.11 s (Figure 3)
  - Athletes with below average VO_2Max (< 40 mL/kg/min) exhibited slower post-fatigue performance (Figure 4)
- Among athletes who exhibited slower post-fatigue performance, 78% had a low VO_2Max value (Table 1; Figure 5)
  - Athletes classified as slower with average post-fatigue sprint time ≥ 0.03 s
  - VO_2Max ≥ 40 mL/kg/min considered to represent "average" aerobic fitness level[5]
- Low VO_2Max associated with 10.67 X greater odds for post-fatigue sprint time decrement (90% CI: 1.24, 91.56)

Figure 1

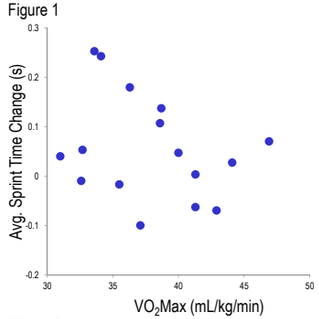


Table 1

VO_2Max (mL/kg/min)	Sprint Time Change	
	Slower	Negligible
< 40	7	3
≥ 40	2	4
Total	9	7

Figure 2

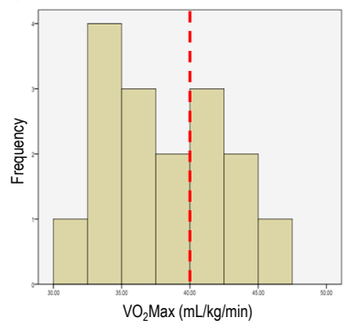


Figure 3

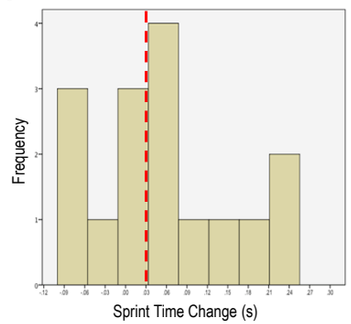


Figure 4

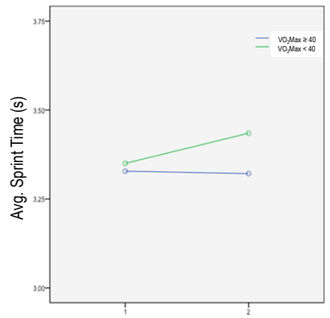
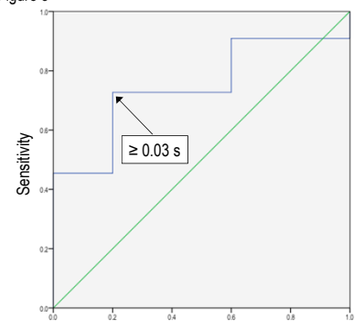


Figure 5



CLINICAL RELEVANCE OF FINDINGS

- VO_2Max appears to have an effect on the ability to perform repeated sprints at a consistent level in a fatigued state
- A high VO_2Max may reduce the likelihood for a substantial anaerobic performance decrease late in competition
- Conditioning of football linemen should include development of both anaerobic power and aerobic fitness
- Repeated sprints with jogging intervals may provide a means for concomitant anaerobic and aerobic conditioning

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