

# DETERMINANTS OF REPEAT SPRINT ABILITY

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## INTRODUCTION

Repeat sprint ability (RSA) describes the ability of an athlete to recover and maintain maximal effort during subsequent sprints; an attribute considered important to most team sports. It is often trained and measured via high-intensity sprints, interspersed with brief recovery bouts ( $\leq 30$ s). Most strength and conditioning coaches agree that for validity and dynamic correspondence, the RSA training session or testing protocol should resemble the work/rest ratio (W/R) and movement mechanics of the sport in question. What is less clear, are the physiological variables most responsible for improving RSA. This, coupled with how to report results, will be the topic of this short article. For the purposes of this paper, the term sprint refers to efforts of  $\leq 10$ s, whereby peak power/velocity could be maintained throughout the repetition.

## VO<sub>2</sub>MAX

Because maximal effort sprints rely on the muscle's stores of adenosine triphosphate (ATP) and phosphocreatine (PCr), both of which are replenished via the aerobic system, many coaches assume that a higher aerobic capacity (VO<sub>2</sub>max) will lead to quicker recovery and better RSA. However, there are conflicting findings regarding this relationship, which appear largely attributable to the RSA test used. For example, a moderate correlation ( $r = -0.35$ ) between VO<sub>2</sub>max and RSA was found when using 8 X 40m sprints with 30s of recovery

between sprints (Aziz et al., 2000) but not 6 X 20m sprints with 20s of recovery between sprints (Aziz et al., 2007). The discrepancy is likely attributable to the length of the sprints used, as this would alter the contribution of the aerobic system (Balsom et al., 1992). In essence,  $VO_2\text{max}$  has not been reported to relate to RSA when sprints of less than 40m (or 6s) have been used (Da Silva et al., 2010). Also, the recovery length between sprints affects RSA (Bogdanis et al., 1996). In some studies, the W/R was around 1/5, which may decrease the significance of aerobic fitness. For example, if recovery is long enough, ATP and PCr can be resynthesized during recovery phases via the aerobic system (Glaister, 2005). If recovery is too short, thus inhibiting PCr repletion, the contribution of anaerobic glycolysis is increased as reflected by higher lactate levels (Glaister et al., 2005).

The issue of whether RSA is affected by a high  $VO_2\text{max}$  seems dependent on the protocol used. In the main, and based on current research, the answer appears to be not as much as first thought. However, this conclusion may be contested when one considers testing validity. Arguably, the biggest issue with RSA testing is the fact that during competition, players are normally expected to maintain RSA over many more sprints than the number used in most of the current protocols. Also, sprints are not done with a unique and constant W/R. Therefore the significance of a high  $VO_2\text{max}$  may be more important only after a certain number of sprints (Thebault et al., 2011). Logically, researchers are skeptical to conclude that  $VO_2\text{max}$  is not an important variable to RSA until protocols of match duration are performed (Castagna et al., 2007).

## **LACTATE THRESHOLD**

Most studies use  $VO_2\text{max}$  as the major indicator of aerobic fitness. However, because  $VO_2\text{max}$  is largely determined by central factors (Basset & Howley, 2000), RSA may more strongly correlate with peripheral factors (Spencer et al., 2005). For example, Da Silva et al., (2010) showed that an RSA test consisting of 7 X 35m sprints (involving a change of direction) and a between-sprint recovery

period of 25s, produced high values of lactate ( $15.4 \pm 2.2\text{mmol/L}$ ) thus demonstrating the large contribution of anaerobic glycolysis. The inability to maintain RSA performance appears subsequent to the accumulation of metabolites, such as increases in lactate, hydrogen ( $\text{H}^+$ ) and the depletion of muscle PCr (Spencer et al., 2005). Logically, Da Silva et al., (2010) found that the velocity at onset of blood lactate accumulation (vOBLA) better correlated with RSA performance ( $r = -0.49$ ); vOBLA reflects peripheral aerobic training adaptations and is associated with an increased capillary density and capacity to transport lactate and  $\text{H}^+$  ions (Bilat et al., 2003; Thomas et al., 2004). Therefore to improve RSA, it appears prudent to target the development of vOBLA.

## **ANAEROBIC POWER**

Da Silva et al., (2010) (protocol aforementioned) and Pyne et al., (2008) (using 6 X 30m sprints with 20s rest) found that the strongest predictor of RSA was anaerobic power i.e., the fastest individual sprint time; this explained 78% of the variance and had a relationship ( $r$ ) of 0.66 respectively. Results suggest that in addition to training targeting the improvement of vOBLA, it should also focus on improving sprint speed, strength and power. RSA appears closely linked with anaerobic qualities including PCr degradation and repletion (Bishop et al., 2004).

## **CONCLUSION**

Based on the above, anaerobic qualities such as strength, power and speed should be increased, along with the athlete's vOBLA; this is regardless of the between-sport variability in RSA demands. It is likely that sports that require repeated high intensity efforts over a prolonged period of time (e.g., >15min), in which athletes are required to cover >40m per interval and regularly produce efforts in excess of 10s, would benefit from training targeting the development of  $\text{VO}_2\text{max}$ .

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