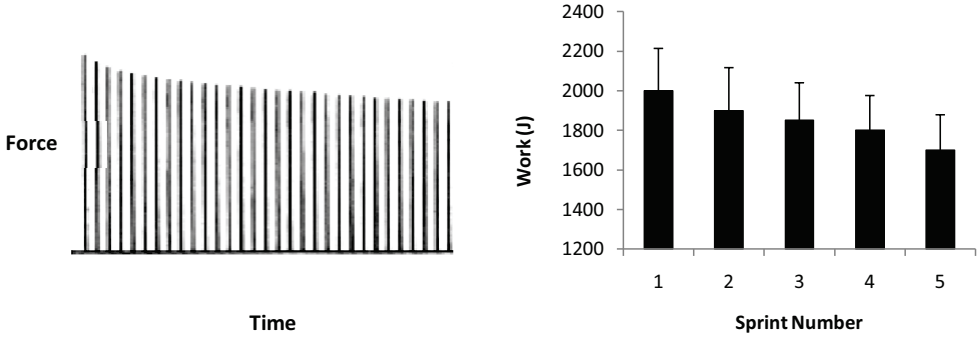
Fatigue during intermittent exercise: novel insights and real-world applications

D.J. Bishop, Institute of Sport, Exercise and Active Living (ISEAL) and School of Sport and Exercise Science, Victoria University, Melbourne, Australia..

There is a reversible decline in the force production of muscles when they are used at near their maximum capacity. This has been classically demonstrated by stimulating repeated short tetani in an isolated fibre (e.g., left-hand panel of figure; Lannergren & Westerblad, 1991). Such experiments have provided valuable insights regarding potential determinants of fatigue (Allen, Lamb, & Westerblad, 2008). Nonetheless, the application of such findings to dynamic exercise has been questioned. However, a similar pattern for the decline in muscle performance can also be observed when athletes are asked to repeat short-duration sprints (< 10 s), interspersed with brief recoveries (< 30 s) (*e.g.* right-hand panel of figure; Bishop, Edge, Davis, & Goodman, 2004). An additional advantage of this approach is that it is possible to investigate the potential influence of neural/brain factors on the fatigue process.



We are interested in how fatigue manifests during intermittent sprint exercise, and the potential underpinning muscular and neural mechanisms. Such information is important as a better understanding of the factors contributing to fatigue is arguably the first step in order to design interventions (*i.e.* training programs, ergogenic aids) that could eventually improve intermittent-sprint ability.

At the muscle level, limitations in energy supply, which include phosphocreatine hydrolysis and the degree of reliance on anaerobic glycolysis and oxidative metabolism, and the intramuscular accumulation of metabolic by-products, such as hydrogen ions, emerge as key factors responsible for fatigue. Although not as extensively studied, the use of surface electromyography techniques have revealed that failure to fully activate the contracting musculature and/or changes in inter-muscle recruitment strategies (*i.e.* neural factors) are also associated with fatigue outcomes. Via the use of deception, it has recently been demonstrated that prior knowledge of the end-point of exercise (*i.e.* sprint number) is also able to influence the mechanical output profile (*i.e.* fatigue) during intermittent sprint exercise.

Allen, D.G., Lamb, G.D., & Westerblad, H. (2008). Skeletal muscle fatigue: cellular mechanisms. *Physiological Reviews* **88(1),** 287-332.

Bishop, D., Edge, J., Davis, C., & Goodman, C. (2004). Induced metabolic alkalosis affects muscle metabolism and repeated-sprint ability. *Medicine & Science in Sports & Exercise,* **36(5),** 807-813.

Lannergren, J., & Westerblad, H. (1991). Force decline due to fatigue and intracellular acidification in isolated fibres from mouse skeletal muscle. *Journal of Physiology,* **434,** 307-322.