

Infographic. Energy availability: concept, control and consequences in relative energy deficiency in sport (RED-S)

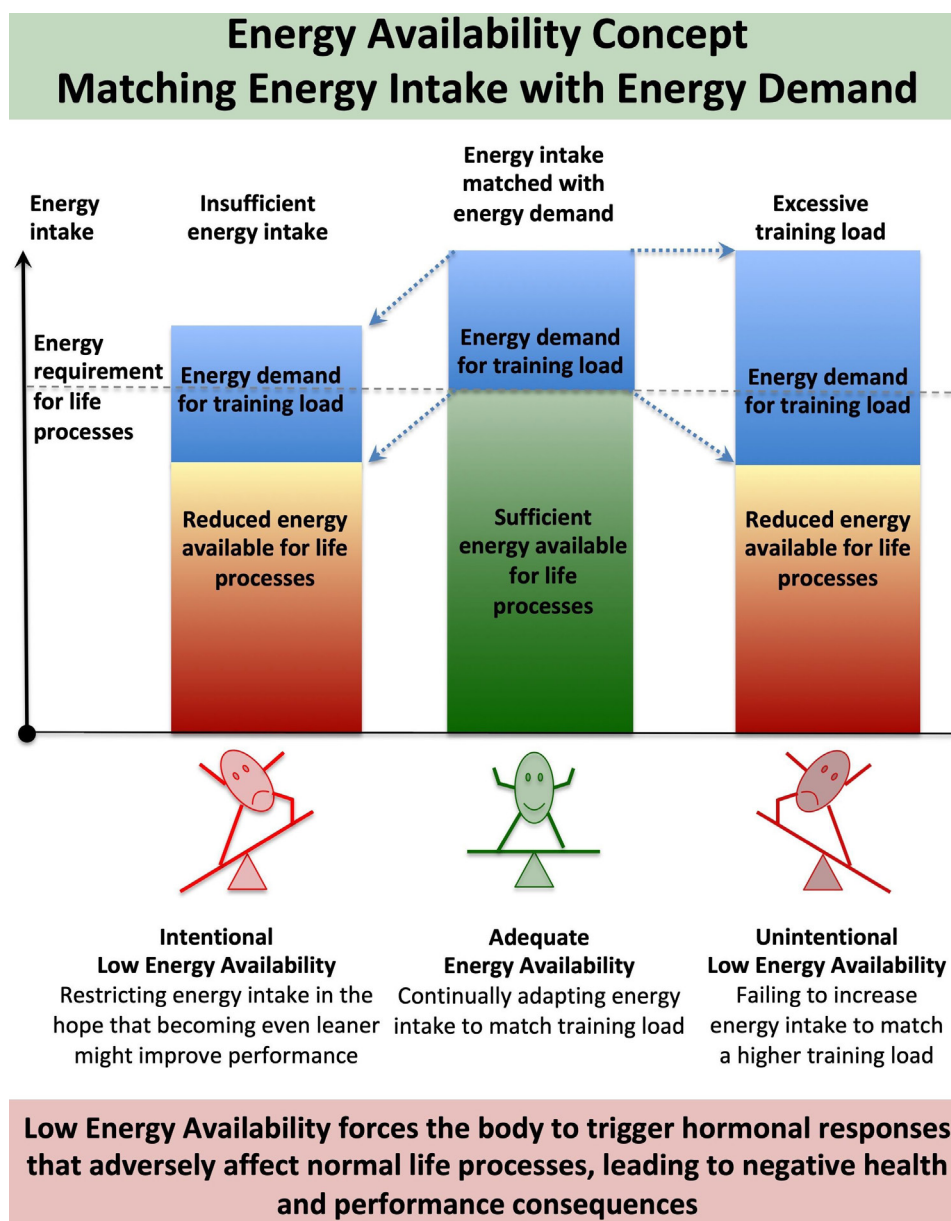
Nicola Keay,¹ Gavin Francis²

Relative energy deficiency in sport (RED-S) is an issue of increasing concern in sports and exercise medicine. RED-S impacts exercisers of all levels and ages, particularly where low body weight confers a performance or aesthetic advantage. Key to mitigating adverse health and performance consequences of RED-S is supporting athletes and dancers to change behaviours. These infographics aim to assist clinicians in

communicating the concepts to exercisers and in implementing effective management of athletes in their care.¹

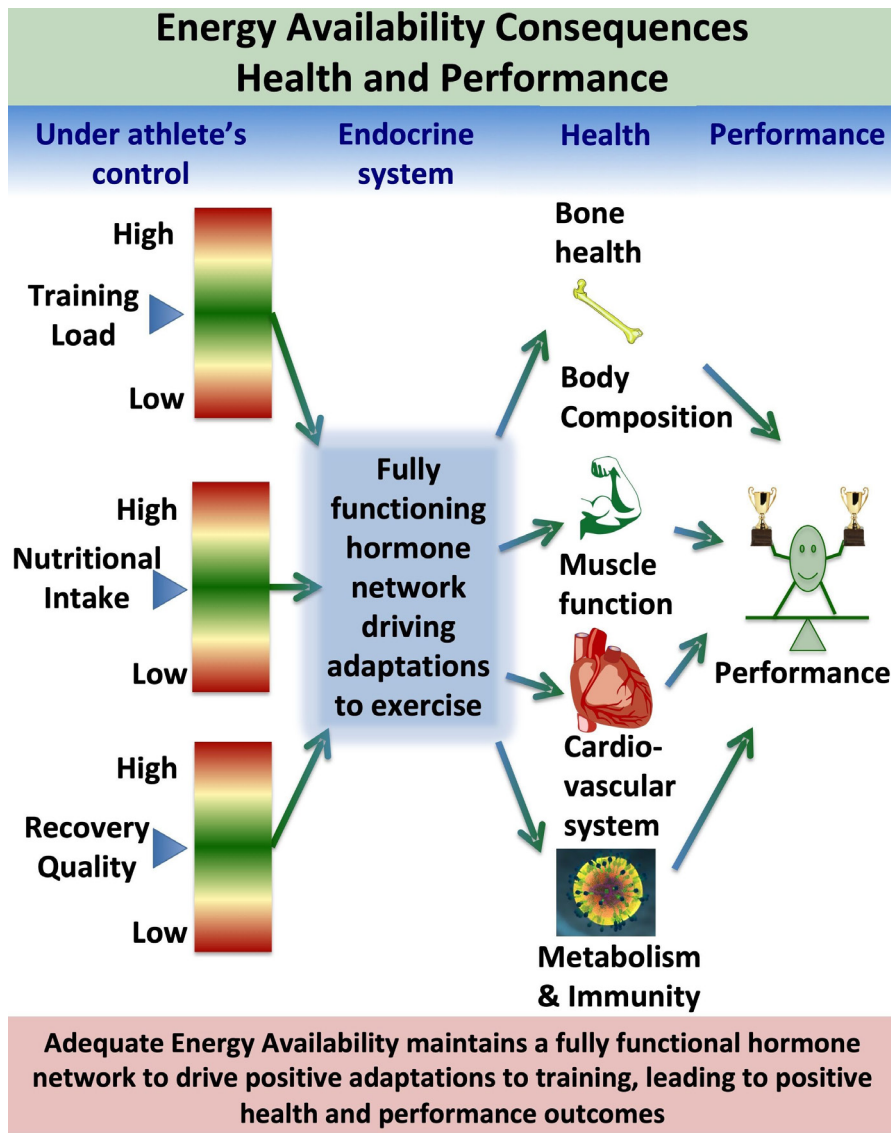
Figure 1 illustrates the concept of energy availability (EA) in RED-S. Preferentially energy derived from dietary intake covers the demands of training, and the remaining energy, EA, is quantified in kcal/kg of fat free mass.² In figure 1, the central bar illustrates adequate EA in an athlete where energy

intake is sufficient to cover the demands of training and fundamental life processes to maintain health. Conversely, low energy availability (LEA) is a situation of insufficient EA to cover basic physiological demands. LEA leads to the adverse consequences of RED-S.³ LEA can arise unintentionally or intentionally, due to a mismatch between energy intake and energy requirement. In figure 1 the bar on the left shows



Dr Nicky Keay: nickykeayfitness.com

Figure 1 Energy availability concept.



Dr Nicky Keay: nickykeayfitness.com

Figure 2 Energy availability control and consequences.

LEA resulting from reduced energy intake with maintained training load. On the right, LEA is a consequence of increased training load with maintained energy intake.

Figure 2 illustrates that EA is under the control of an athlete.⁴ The three behaviours relating to training, nutrition and recovery determine EA. Integrated periodisation of these behaviours results in optimal health and performance. Conversely, an imbalance in these behaviours results in suboptimal function. LEA occurs in the case of high

training loads, relative to nutritional intake. Thus, this figure reinforces the important point in the IOC statements on RED-S that psychological factors which determine these behaviours are key to the development, continuation and management of RED-S.^{2,3}

Figure 2 also shows the temporal, synergistic effect of these behaviours to ensure a fully functioning endocrine system. Hormones are key to health and to drive positive adaptations to exercise, to improve athletic performance. Thus hormones can

be informative in tracking the response of an individual to these three input variables. Furthermore, endocrine markers relate to the RED-S clinical outcome of stress fracture in athletes, being more reliable as objective, quantifiable indicators of EA than numerical calculation of EA from direct assessment.⁵

¹Department of Sport and Exercise Sciences, Durham University, Durham, UK
²Science4Performance, London, UK

Correspondence to Dr Nicola Keay, Durham University, Durham DH1 3LY, UK; nickykeayfrancis@googlemail.com

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