Symposium 1: Nutrition and Physical Activity

Diet, genes and exercise performance

Mark Hargreaves
Centre for Physical Activity and Nutrition Research, School of Health Sciences, Deakin University, Burwood, VIC 3125

The importance of nutrition, in combination with appropriate training, for successful exercise performance has been recognised for many years. Considerable emphasis has rightly focused on energy, carbohydrate and fluid balance, and nutritional strategies are designed to prevent the well documented ergolytic effects of carbohydrate depletion and dehydration on endurance exercise performance.[1] In addition, attention has focused on the role on nutrition in promoting optimal biological adaptations to training, again with an emphasis on carbohydrate and fluid balance, but with emerging interest in the role of protein intake.

In recent years, advances in molecular biology techniques have allowed investigation of the effects of exercise and diet on skeletal muscle gene expression and of the importance of the genotype in determining the biological responses to exercise and dietary interventions. It is clear that a number of putative genes have associations with cardiorespiratory endurance, muscle strength and metabolism, specific characteristics of elite athletes and with training adaptability.[2] A challenge in the years ahead is to assess the relative importance of the genotype and the environment in determining the final "elite performance phenotype".

A relatively simpler task has been examination of the effects of exercise and dietary intervention on gene expression in human skeletal muscle.[3] A single bout of exercise increases the rate of transcription and the mRNA levels of a number of metabolic genes during and after exercise.[3,4] The increases are most marked during recovery from exercise and are transient, suggesting that the long term effects of exercise training may be the result of ongoing and repeated increases in mRNA, ultimately leading to steady-state increases in expression of key proteins involved in energy metabolism. Cessation of training results in a rapid reversal of many adaptive responses. Interestingly, recent results suggest that the increases in gene transcription may be influenced by the preceding diet, most notably the availability of muscle glycogen [5] and blood glucose (Hargreaves et al., unpublished). We have also observed that short-term manipulation of dietary carbohydrate and fat intake modifies the expression of genes within muscles of athletes maintaining their normal training.[6] Our recent observation of nuclear translocation of AMP-activated protein kinase during exercise provides a potential mechanism linking metabolic events within contracting muscle to gene transcription.[7]

References

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