

# Substrate Metabolism During Ironman Triathlon: Different Horses on the Same Courses

Sports Medicine

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## Abstract

Ironman triathlons are ultra-endurance events of extreme duration. The performance level of those competing varies dramatically, with elite competitors finishing in ~ 8:00:00, and lower performing amateurs finishing in ~ 14–15:00:00. When applying appropriate values for swimming, cycling and running economies to these performance times, it is demonstrated that the absolute energy cost of these events is high, and the rate of energy expenditure increases in proportion with the athlete's competitive level. Given the finite human capacity for endogenous carbohydrate storage, minimising the endogenous carbohydrate cost associated with performing exercise at competitive intensities should be a goal of Ironman preparation. A range of strategies exist that may help to achieve this goal, including, but not limited to, adoption of a low-carbohydrate diet, exogenous carbohydrate supplementation and periodised training with low carbohydrate availability. Given the diverse metabolic stimuli evoked by Ironman triathlons at different performance levels, it is proposed that the performance level of the Ironman triathlete is considered when adopting metabolic strategies to minimise the endogenous carbohydrate cost associated with exercise at competitive intensities. Specifically, periodised training with low carbohydrate availability combined with exogenous carbohydrate supplementation during competition might be most appropriate for elite and top-amateur Ironman triathletes who elicit very high rates of energy expenditure. Conversely, the adoption of a low-carbohydrate or ketogenic diet might be appropriate for some lower performance amateurs (> 12 h), in whom associated high rates of fat oxidation may be almost completely sufficient to match the energy demands required.

## Electronic supplementary material

The online version of this article (<https://doi.org/10.1007/s40279-018-0938-9> (<https://doi.org/10.1007/s40279-018-0938-9>)) contains supplementary material, which is available to authorized users.

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## Notes

## Compliance with Ethical Standards

## Funding

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## Conflict of interest

Daniel J. Plews competes in Ironman triathlons and coaches elite Ironman triathletes. Ed Maunder and Andrew E. Kilding declare that they have no conflicts of interest relevant to the content of this article.

## Supplementary material

[40279\\_2018\\_938\\_MOESM1\\_ESM.xlsx](#) (47 kb)  
Supplementary material 1 (XLSX 47 kb)

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