1. Introduction to Nutrition and Supplements in Cycling

Authors

S. Andy Sparks[1], Neil D. Clarke[2], Lewis A. Gough[2]

Affiliations

1 Sports Performance, Exercise and Nutrition Research Group, Edge Hill University, UK

2 Human Performance and Health Research Group, Centre for Life and Sport Sciences (CLaSS), Birmingham City University, UK

ORCID ID's and emails

S. Andy Sparks www.orcid.org/0000-0003-0910-2225 (sparksa@edgehill.ac.uk)

Neil D. Clarke https://orcid.org/0000-0002-1909-329X (neil.clarke@bcu.ac.uk)

*Lewis A. Gough www.orcid.org/0000-0003-1115-7559 (lewis.gough@bcu.ac.uk)

*Corresponding author

Introduction

The need for optimal nutritional strategies has led to the evolution of the generic Applied Sport and Exercise Science practitioner into the Sport and Exercise Nutritionist, and the career of Performance Nutrition, which have become an integral part of elite sport. In cycling, these practitioners have become a vital aspect of the support systems that are designed to enable riders to cope with extremely high training volumes and intensities. The demands on these athletes are severe because of the training requirements, and an often prolonged racing season, during which successive racing days are commonplace. Specific nutritional strategies are therefore vital to optimise performance and health (Clauss et al., 2023). With the increase in nutrition practitioners in high performance cycling, there has also been a concomitant increase in research interest in cycling nutrition. Indeed, if we consider the sheer number of journal article publications that have been published since the 1980's to the present day, there has been a near exponential rise, certainly since the year 2000 (Figure 1.1). Improved knowledge and understanding of the most appropriate nutrition strategies has made it easier for practitioners

to employ evidence-based nutrition to ensure optimal fuelling, prior to and during exercise, maximise recovery prior to the next bout of training or racing, and enhance adaptations to training.

<Figure 1.1 here>

Optimal physiological conditioning is essential to cycling performance, where the energy demand for cycling is primarily met by the interaction of aerobic and anaerobic ATP regeneration processes. More specifically, activity can be categorised as 'explosive efforts' (up to 6 s in duration, with preponderance of the 'phosphagens' metabolic pathway), 'high intensity efforts' (>6 s and up to 1 min in duration, with preponderance of the glycolytic pathway), and 'endurance intensive efforts' (> 1 min in duration, with preponderance of the oxidative phosphorylation pathway) (Chamari and Padulo, 2015). The demand placed on the contribution of each of the energy systems is not only dependant on athlete conditioning, but also the cycling event, mainly distance, duration, and terrain. Whilst short distance track and road cycling races tend to place greater demand on anaerobic metabolism and should be considered high intensity efforts, longer distance events such as pursuits, the Maddison, road races and long-distance time trials are recognised as being endurance intensive efforts. These longer duration efforts have a greater reliance on the oxidative phosphorylation pathway (Jeukendrup et al., 2000), but it is important to remember that all the pathways are active all the time, and that their proportional contribution to energy turnover is dependent on the nature of the exercise.

Whilst the proportion of the contribution of each energy system differs by event or training session, to be successful in medium duration track events (such as the 4 km pursuit), both the aerobic and anaerobic powers and capacities need to be maximally developed (Craig & Norton, 2001). Even in long duration submaximal cycling events there will be periods of variable power output that may occur as a consequence of changing environmental conditions, terrain, race dynamics of the peloton and in the final sprint finish period of competition that place greater reliance on anaerobic metabolism (Kolsung, Ettema, & Skovereng, 2020). Each of these physiological demands requires nutrition strategies that can optimise adaptations to specific training sessions and the demands of the events and races themselves.

The popularity of cycling and associated increase in research output has led to more widespread proliferation of what we now know, and this has also clearly infiltrated the mainstream media.

This has almost certainly been influenced by the advent of social media, through which many more athletes have access to nutrition information, some of which is research evidenced/informed, some not (Dunne et al., 2019). What is clear is that many people understand that appropriate nutrition is required for optimal performance, and that this can be the difference between getting a medal or not, or between winning, loosing or even finishing an event. What is less clear, and often forgotten, is that most strategies have some nuance, and they can be context and athlete specific. This has ushered in the individualised and periodised nutritional intake strategies often employed in elite riders, but which remain less well understood and implemented in recreational and amateur cyclists.

There is clearly a need to provide a "go-to" publication that considers the current state of the research evidence for the nutritional strategies that can be employed to enhance cycling training, recovery, and performance. We have therefore put together a group of the world's best researchers, practitioners, and athletes, to contribute their expertise on this fascinating subject of cycling nutrition. The diverse author list includes practitioners working at UCI WorldTour and ProTeam level (BORA-Hansgrohe, INEOS Grenadiers, and Uno-X Pro Cycling), and researchers from Europe, the USA, South America, and Australia. The author teams on each of the chapters provide expert evaluations of each of the topics, current practices and they provide recommendations and practical considerations for athletes and practitioners to make informed decisions.

We have structured the book into two main parts. Initially we critically evaluate the fuelling and nutritional considerations for performance, health, body composition and cycling in extreme environments across a range of cycling events. This is to provide the cyclist with the key areas of focus on to optimise performance and in some places, health. In the second part of the book, we have focused on the supplements that are considered 'evidence-based' initially, followed by a discussion of some of the novel and popular supplements being used in cycling today, where we review the evidence for their use. To present this clearly, we have structured each section to firstly cover the general physiology, followed by the nutritional interventions that could be effective to help optimise outcomes. In the final chapter, we provide a performance nutritionist's reflection of working in professional cycling during Grand Tours, and a suggestion for practitioners about how they too can use reflective practice to enhance their performance. We hope you find this book valuable and enjoy it as much as we have enjoyed putting it together.

Figure Legends

Figure 1.1 - Mean (± SD) annual number of publications listed on www.pubmed.gov using the search terms* "cyclist OR cycling AND nutrition AND performance AND athlete". (*) search limited to human species publications.

References

Chamari, K. & Padulo, J. (2015). 'Aerobic' and 'Anaerobic' terms used in exercise physiology: a critical terminology reflection. *Sports Medicine Open*, 1, 9. https://doi.org/10.1186/s40798-015-0012-1

Clauss, M., Skattebo, Ø., Dæhli, M.R, Valsdottir, D., Bastani, N.E., Johansen, E.I., Kolnes, K.J., Skålhegg, B.S., & Jensen, J. (2023). Carbohydrate Ingestion during Prolonged Cycling Improves Next-Day Time Trial Performance and Alters Amino Acid Concentrations. *Medicine and Science in Sports and Exercise*, Aug 2023 (Epub ahead of print). https://doi.org/10.1249/mss.0000000000003264

Craig, N. P. & Norton, K. I. (2001). Characteristics of Track Cycling. *Sports Medicine,* 31, 457-468. https://doi.org/10.2165/00007256-200131070-00001

Dunne, D.M., Lefevre, C., Cunniffe, B., Tod, D., Close, G.L., Morton, J.P., & Murphy, R. (2019). Performance nutrition in the digital era - An exploratory study into the use of social media by sports nutritionists. *Journal of Sports Sciences*, 37(21):2467-2474. https://doi.org/10.1080/02640414.2019.1642052

Jeukendrup, A. E., Craig, N. P. & Hawley, J. A. (2000). The bioenergetics of world class cycling. *Journal of Science and Medicine in Sport,* 3, 414-433. https://doi.org/10.1016/s1440-2440(00)80008-0

Kolsung, E.B, Ettema, G, & Skovereng, K. (2020). Physiological Response to Cycling with Variable Versus Constant Power Output. *Frontiers in Physiology*, 11:1098. https://doi.org/10.3389/fphys.2020.01098