

Nutrition for Female Athletes: what we know, what we don't know, and why

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Abstract

Men are often considered as the default sex for studies in sports nutrition. Indeed, most of the seminal work to date in sports nutrition has been exclusively conducted on male participants. The 2021 Olympic Games had 49% female participation, signalling [almost] parity between sportsmen and sportswomen at the most elite sporting level for the first time. The volume of sports nutrition research using women as participants has, however, not kept pace with this rise in participation and professionalism. Therefore, to highlight what we currently know and don't know about sports nutrition for female athletes we invited well-known and emerging researchers to contribute to this special edition on Nutrition for Female Athletes. Contributions cover three main themes: dietary and hydration requirements; low energy availability and making weight; and dietary supplements and gut health. In addition, this special addition explores why our understanding on this topic is limited and how we can further progress and promote this research area.

In 1949 Simone de Beauvoir stated that *man* is considered the default while *woman* is considered 'the other' [1]. To what extent this paradigm has applied to various spheres of society may be debated by many, but it seems plausible for this to have been the case in sports nutrition. For example, it is noteworthy that the seminal research from the 1960s that established the foundations of current sports nutrition research and practice, was carried out predominantly on male participants by male researchers [2,3]. This asymmetry in research may not have been a deliberate snub but may reflect the global cultural and socio-political context of the times, which showed a sexual dichotomy favouring men for participation in exercise and competitive sport. The participation of women in the summer Olympics may be taken as a representative example: in 1900 female representation was 2%, in 1964 it increased to 13%, and in the most recent 2021 Games it was 49% [4]. However, as participation of women in sport has moved towards parity at the elite level, research on nutrition for female athletes has lagged behind. Recently it was shown that 6% of mainstream sport and exercise science research was conducted using female only participants [5] and the likelihood is that this number would be further reduced when considering sports nutrition research using only women as participants. It is therefore evident that scientific research on female athletes is still lacking, and in the context of a global pandemic and the international climate change crisis, the interconnectedness of all spheres of society has become evident and inclusivity has become not an option but a necessity. Therefore, to showcase current knowledge and practice in female-specific nutrition and to comment on the direction of future research in this field, we invited a group of established experts and emerging

researchers to contribute to this special edition on *Nutrition for Female Athletes* in the *European Journal of Sports Science*.

Theme 1: Dietary and hydration requirements

Substrate metabolism, carbohydrate and protein requirements, and hydration are prominent topics in sports nutrition, which are fundamental for the optimisation of training adaptation, health, and performance. Herein, Bossieau and Isacco [6] provide an update on the intricacies of how the menstrual cycle-related hormone fluctuations can influence metabolism and modulate substrate oxidation in females. Moore et al.[7] offer recommendations on carbohydrates and protein requirements based on the current knowledge, as well as highlighting current gaps in knowledge and providing directions for further research. Rodriguez-Giustiniani et al. [8] outline the effects of menstrual cycle hormones on fluid and electrolyte balance and how this may affect fluid and electrolyte requirements.

Theme 2: Low energy availability and making weight

Underfuelling is a current hot topic in sports nutrition and this area of research has historically been conducted in females, due to the effect of low energy availability on menstrual function (i.e., secondary amenorrhea), although knowledge in this topic is still not complete. In this issue, Heikura et al. [9] provide commentary on the current knowledge gap related to clinically-relevant, field-based parameters for the early detection of low energy availability. Langan-Evans et al. [10] provide careful consideration of and practical recommendations on the nutritional strategies for female athletes making weight in weight category sports.

Theme 3: Dietary supplements and gut health

To support training adaptation and peak performance, both dietary supplements and a healthy gastrointestinal tract are important. In this issue, Sheridan et al. [11] provide insights on supplements that may be beneficial to support training and performance in elite female footballers. Saunders et al. [12] provide a focused analysis on the effects of sodium bicarbonate supplementation for improving high-intensity exercise capacity. Pugh et al. [13] provide a thought-provoking analysis of the known and unknown differences in the functioning of the gastrointestinal tract at rest and during exercise between female and male athletes.

This special issue provides an update on current knowledge in female-specific sports nutrition and highlights the need for further female-specific research in most areas of sports nutrition. We hope

that this special edition of EJSS serves as a *call to action* to researchers, practitioners, funding bodies, academic institutions, scientific journals, and sporting organisations, to (i) do this much-needed research, (ii) provide the necessary resources to bridge this knowledge gap, and (iii) overcome any potential challenges to conducting this type of research, thus allowing female athletes to flourish.

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