

Understanding female endurance athletes' knowledge of carbohydrate requirements for activity.

Abstract

The aim of this research project is to gain an understanding of female endurance athletes' attitudes and knowledge of carbohydrate requirements for endurance-based activities. Current literature suggests that endurance athletes consume less than the recommended amount of carbohydrates, though whether this is unintentional or intentional is unclear. Appropriate carbohydrate intake is important to fuel endurance activities and prevent low energy availability (LEA) which can develop into Relative Energy Deficiency Syndrome (RED-S). The first objective of the research is to establish current practices of carbohydrate consumption during endurance training. The second objective is to determine the knowledge and understanding on carbohydrate requirements to fuel endurance activities and during the recovery phase following the activity. Together, this will allow an understanding of whether practices are influenced by athletes' knowledge or any other factors.

Introduction

Endurance sports, also known as aerobic training, are typically characterised by repeated isotonic contractions of large muscle groups, for example, running, swimming and cycling (Morici *et al.*, 2016). It involves muscular contractions of a lower force and power production for extended periods of time (Best 2020). The primary source of energy during these activities are carbohydrates and ensuring high availability before, during and after endurance exercise is critical for optimising performance and promoting recovery. Carbohydrate intake is critical for the maintenance of blood glucose concentrations and to maximise skeletal and hepatic glycogen stores prior to exercise (Podlogar *et al.*, 2022). There are varying recommendations and targets for carbohydrate intakes, dependent on exercise duration and intensity. For example, the American College Sports Medicine, recommend 6-10g/kg of body weight for endurance training (i.e. 1-3 hours a day of moderate-high intensity exercise) and 1-4g/kg of body weight 1-4 hours prior to an activity lasting >60 minutes (Thomas *et al.*, 2016). These

requirements are higher than those for strength and power athletes, (i.e. 3-7g/kg body weight per day) (Jäger *et al.*, 2017). Exogenous carbohydrate intake during endurance activity is important and can be a limiting factor in activities >90 minutes if intakes are insufficient (Burke *et al.*, 2004). In addition to volume, the timing and periodisation of carbohydrates plays a key role in performance and recovery. Post-exercise intake of carbohydrate is advantageous due to multiple factors, including increases in insulin sensitivity and permeability of muscle cell membranes to glucose (Burke *et al.*, 2004).

Despite the robust data highlighting the importance of adequate fuelling for endurance activities, athletes are often found to be under fuelling, either intentionally or unintentionally. A survey conducted by Baranauskas *et al.*, (2015) found that 80.8% of 146 endurance athletes were consuming below the recommended amount of carbohydrates and 70% were consuming higher than the recommended amounts of saturated fat. A review of the dietary survey literature shows that female endurance athletes are less likely to achieve carbohydrate recommendations, due to the desire to achieve lower levels of body fat to improve performance (Burke *et al.*, 2012). This is counterintuitive, given the high energy and carbohydrate demands of endurance activity. Insufficient energy intake in female athletes can lead to the female athlete triad, encompassing a cluster of symptoms related to LEA including low bone mineral density and menstrual cycle disturbances. A consensus led by The International Olympic Committee (IOC) have now introduced the term RED-S, to highlight that these physiological and psychological consequences of LEA can also affect males (Grabia *et al.*, 2024). Despite data highlighting that athletes are often under fuelling, it is unclear if this is always intentional (e.g. the desire to reduce body fat/mass) or unintentional (e.g. lack of knowledge and understanding), or a combination of both. Furthermore, there is limited data on whether age plays a role.

Methodology

This proposed research will use an online survey proposing questions to gain a better understanding of carbohydrate fuelling practices in female endurance athletes. The survey will be integrated into Microsoft Forms which will be distributed, with consent, to participants. The research project will be a cross-sectional study, providing a

snapshot of data at one point in time, which is suitable for data collection under time constraints (Setia 2016). It is a useful method to explore the knowledge and attitudes of individuals with regards to health-related matters (Mohajan 2020). The research project will use a mixed methods approach, combining both quantitative and qualitative data collection which will be incorporated into the survey. Utilising a mixed-method approach allows one to establish more comprehensive and robust findings, enhancing the value of the research (Swift *et al* 2010). Quantitative methodology tests objective theories by analysing the relationship between variables using numerical data (Creswell 2003). In a survey, this can be obtained through closed-ended questions e.g. multiple choice, Likert scale, or dichotomous questions. Qualitative methodology allows researchers to explore why or how phenomena occur, by exploring and capturing individuals' opinions and experiences (Fetters *et al.*, 2013). Qualitative data in a survey can be obtained from open-ended questions which allow participants to provide a response in their own words. Due to time and resource constraints for this research project, only a small sample of participants would be achievable using alternative data collection methods e.g., one-to-one interview or focus groups. Using an online survey, which can be distributed via a hyperlink to participants' email or phone number will allow a larger number of responses.

The target demographic for this research project is adult female endurance athletes. Eligibility criteria will include females aged between 19-65 years old who participate in endurance training/sport. A review by Jones *et al* (2000) considers endurance exercise to be any continuous activity lasting from 5 to 240 minutes completed at around 65-100% of $VO_{2\text{ max}}$. However, a narrative review by Spiering *et al* (2021) identified that, in general populations, endurance performance can be maintained for up to 15 weeks when training frequency is as low as two sessions per week (13-26 minutes) if intensity is maintained. As such, eligible participants will need to be participating in an endurance activity lasting from 30-240 minutes, at least twice a week. The sampling strategy will use opportunistic sampling via the principal researcher's friends and associates. A sampling frame will include a complete list of potential participants from existing social and professional contacts. Admittedly, this increases the selection bias, however it is a pragmatic approach given logistical constraints.

Statistical data analysis will be carried out using SPSS statistical software. Descriptive statistics will include arithmetic means to summarise central tendencies and standard deviation to assess variability. Statistical tests such as T-tests and ANOVA (Analysis of Variance) will be used to compare means between groups. Furthermore, correlation analysis will be used to measure the strength and direction of any linear relationships between two variables e.g. Pearson's or Spearman rank correlation. Qualitative data analysis will be conducted using the NVivo software tool to enable organisation and visualisation of the qualitative data set. NVivo promotes a structured and systematic approach to qualitative data analysis and is tailored to explore and categorise text-based data (Kraiwanit *et al.*, 2023).

Conducting a survey involves ethical considerations which need to be addressed. Firstly, participants will need to be informed of the purpose of the research, the nature of their participation and how the results will be used prior to commencing the survey. This will be presented to participants in an information form prior to starting the survey. They will also be informed of the survey's estimated completion time. This form will also emphasise that participants have the right to withdraw from the survey at any point without needing to provide a reason. Participants will finally be asked for their consent before proceeding with the survey. All data will be kept in password protected cloud storage on the University Office 365 system which will not be shared. Any USB sticks used to store or transfer data will be password protected. All participants will be given a unique identifier to ensure confidentiality, and this list will be kept securely in the password protected folder. The survey will include questions relating to food intake and knowledge, which may cause anxiety in some participants. In attempt to allay any anxiety, participants will be signposted to public health recommendations for healthy eating at the end of the survey. An ethics application form will be submitted to the University of Wales Trinity St David's ethics panel for review, prior to any data collection.

The results of this research project have the potential to provide a better insight into the current fuelling practices, and the influence of external sources of information on their

knowledge and understanding. This research has the potential to inform sports nutritionists, physiologists and coaches on gaps in athletes' knowledge and strategies which could be implemented to improve their understanding, and thus performance.

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