

Research Methods Reflection

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What is the relationship between carbohydrate awareness and energy availability in non-elite ultra-runners?

Introduction: The Research Problem

During the start of the research process and developing my research proposal and literature review, I formulated notes on the types of research I wanted to conduct and the specific areas of research I wanted to investigate. I found the problem through examining the research literature and finding supporting research to provide an adequate reason to start my investigation.

The literature suggested that endurance athletes do not meet recommendations for nutrients (Klein et al 2021), in particular carbohydrates (McLeman, Ratcliffe and Clifford 2019; Beermann et al 2020). As a sub-group of endurance athletes, ultra-runners lack specific nutrition knowledge (Stellingwerf 2016) and fail to meet nutritional recommendations (Blennerhassett et al 2019). Ultra-runners high volume training requires increased energy needs (Tiller 2019). However, increased energy needs may negatively impact energy availability in athletes and increase the risk of RED-S (Heikura, Stellingwerff, and Areta 2021; Stenqvist, Torstveit, Faber, and Melin 2020). Energy deficiencies from low nutrient intake also contribute to RED-S and low energy availability (LEA). Stellingwerff et al (2020) suggest that nutrient energy deficiencies are often due to carbohydrate intakes below recommendation, rather than other macronutrients such as fat and protein. Therefore, the research problem was framed as LEA results for high-volume training and low carbohydrate intake, ultra-runners do not meet carbohydrate recommendation and suffer from poor nutritional knowledge. This allowed me to develop my research question to describe the association between nutrition knowledge, specifically carbohydrates, and energy availability. In addition, this also pointed and helped me formulate the research design to answer this question and the methods I would need to do this. I chose a quantitative research question as they are

more focused on investigating associations between two variables and exploring 'what is' the relationship (Creswell and Creswell 2018). Additionally, a range of measures would be needed in order to accurately assess awareness, energy intake and energy expenditure. My research question is:

'What is the relationship between carbohydrate awareness and energy availability in non-elite ultra-runners?'

This question was suitable for the study as it clearly defined an independent variable (carbohydrate awareness) and a dependent variable (energy availability), within a specific population (non-elite ultra-runners). I was aware to use the term awareness as a sliding scale over the use of knowledge. The research question helped me to It addressed the problem and informed me of the type of research, the research design, and the methods I would need to use to answer it. There were four specific areas that I would need to do:

1. Organise a participant group of non-elite ultra-runners. I would need to use exclusion and inclusion parameters for this group and use a questionnaire to screen participants against these parameters.
2. Measure the level of carbohydrate awareness in the group. This would need to utilise a validated questionnaire to measure this data.
3. Measure levels of energy availability within the group. This was a much more difficult task and would rely on a range of septic data collection methods, estimates and formulas.
4. Provide a statistical analysis of the two variables to investigate and describe if an association exists between carbohydrate knowledge and energy availability, and what is the strength of that relationship.

Research Design and Methods

I chose a descriptive correlation design study as the most suitable study for investigating my research question. This type of study design is used to describe the association between two variables (Drummond and Murphy-Reyes 2018), where an independent variable influences

the dependent variable (Lappe 2000). Descriptive design studies collect data on different variables without providing an intervention or manipulating the variables. They also differ from observation experimental designs as they do not include comparison groups. These types of designs can be used to develop theory and identify problems (Drummond and Murphy-Reyes 2018). I chose a descriptive quantitative design, using a correlation design study because:

1. Suitability to the research question. I initially wanted to organise an interventional experimental design study. However, this type of study was neither suitable for answering my research question, or feasible within the time and resources I had available. My research question framed an independent variable (carbohydrate knowledge) and a dependent variable (energy availability). To answer this question, I needed a study design that would explore the relationship between these two variables and measure and describe if there was association. I wanted to explore what was happening in the real world, specifically in ultra-runners as a sub-group of endurance athletes, as research had suggested these group of athletes had higher training volumes and greater energy needs (Tiller et al 2019) but also suffered from poor nutritional knowledge (Blennerhassett et al 2019).

2. Population Snapshot. This type of descriptive study design provides a focus on a defined population at a specific time (Aggarwal and Ranganathan 2019). My research question aimed to investigate the current nutrition knowledge and status of ultra-runners. I did not need to compare this population to other groups, such as 10k runners as it was not relevant to the research question or research problem. In addition, the timeframe was important, as this type of design provided a snapshot of ultra-runners habits, attitude, behaviours and knowledge at a particular time, rather than changes or developments over a period of time. This would then allow the outcomes of the study to develop theory, and provide preliminary research the basis for further studies with alternative study designs that might include interventions (Lappe 2000)

3. Time and resources. Descriptive research design studies are quicker and less reliant on resources (Lappe 2000), therefore are suitable to organise with limited time and limited resources (Setia 2016). In addition, the non-interventional approach also provided access to

a greater sample size and greater representation of the ultra-running population. I had limited access to resources and only a short amount of time to organise the study and provide outcomes of the research. I also wanted to ensure that I had a suitable sample size to investigate correlation and be varied enough to adequately represent ultra-runners. Therefore, this type of research design was very effective.

4. **Methods.** With this study design, once the sample group has been chosen based on the inclusion and exclusion criteria - ultra running experience in this study - the methods of data is assessed to analyse and report the outcomes (Setia 2016).

5. **Research methods.** The research design provides the approach to answer the research question, whereas the methods are used to put the plan into action. Through the development of the research design, this provided me with the types of methods and resources needed to answer the question. For this type of research design, I wanted to capture the snapshot of ultra-runners and measure a range of value to create variables. Therefore, surveys, questionnaires, and other methods to collect data where appropriate. I provide more details in the methods section.

I was also aware of the disadvantages of this study, particularly when selecting my sample group, as the reliability of this study design relies on the participant group being representative of the group or population being studied and that the methods used were accurate, reliable, and standardised across the study (Aggarwal and Ranganathan 2019). I had to ensure that my sample group accurately reflected typical non-elite ultra-runners, and the instruments used to measure this participant group were both accurate and the same for each participant. I feel that I selected the appropriate study design to answer my question and allowed me to be an investigator of a real-world issue. I was able to make the most of the time and resources I had available and investigate a larger group size to provide a more reliable outcome of the state of nutrition knowledge and energy availability of non-elite ultra-runners. Even though the results are not what I predicted, the research design allowed me to answer the question and reveal a strong association between other independent variables and the dependent variables that could form the start of further studies.

I broke down the study into distinct stages

1. Organise all materials and set up workspaces. Produce any instructional videos and instruction documentation. Produce documentation about the study, including a study brief and info page. Construct email texts to send to participants for each stage of the study.
2. Search and make a list of reputable ultra-running coaches
3. Contact ultra-running coaches with details of the study and invite participants.
4. Manage and screen participants by email and provide a link to an initial screening questionnaire.
5. Use data from screening questionnaire to set up Nutritics accounts and training logs for all participants. Issue and collect consent forms.
6. Check on each participant's Nutritics account every three days and send email to offer help if needed. Provide a thank you email once complete and remind participants to send in training logs.
7. Send link to the participants final stage of the study, the carbohydrate knowledge quiz.

I created a process for organising and managing the data. I had to use several formulas to estimate METS equivalents, body fat percentage, fat free mass and energy availability. Therefore, to help organise, manage, and produce this data I constructed a number of calculators using different formulas on excel. I used these as part of a process. At each stage of the process novel insights emerged from the data, often unexpected.

To organise and manage all the data I kept several spreadsheets and used Microsoft forms as a method of data collection. All data collection was online using Microsoft forms, excel and Nutritics. I initially created a screening questionnaire for all participants to complete, this included details of age and anthropometric data, training history, details of injury and experience. Once participants completed the questionnaire, I provided them with a unique id and used the data to set up a Nutritics account and training log. I emailed every participant directly and avoided group emails, therefore there was no chance data could be shared by accident. I also limited any personal details in attachments and used online forms, such as Microsoft forms to capture any personal data. I kept two spreadsheets, this first was to track every participant with their unique id, this spreadsheet was organised into stages of the study and provided dates for completion of each stage. It also provided notes and dates to send out

check ins and reminder emails to participants, this helped me to manage and organise all the data. Participants id was used on the spreadsheet, and a copy of it was kept backed up on a local drive and on Dropbox. The spreadsheet was password protected and any distinguishing data was removed. A separate spreadsheet existed with the id and the participants as a reference. The first stage of the study was to complete the questionnaire. Email addresses were kept as replies on the email system, limiting the amount of personal data stored locally. The second stage of the study included setting up a Nutritics account and a training log. Personal data from the questionnaire was used and an id number allocated to the training log and Nutritics. The third stage of the study consisted of completing the quiz. No personal data, apart from id, was asked for during the quiz. This was all online and scores were marked on a new spreadsheet that was used to collect data for entry into SPSS. A password protected local copy was kept along with a secure password copy on Dropbox.

The Participant Group

From the outset, I realised to make the study work I needed buy-in from the participants and to make the study feel worthwhile to them, and they would be rewarded by it. I was also aware of not overwhelming them with too much paperwork, questionnaires, or tests. As I had predicted at each stage of the three stages of the study participant numbers would drop off. I was surprised that I kept all participants, apart from losing one, in the final stage. This I feel is through tracking each participant individually and keeping them informed of the study, providing knowledge about the study, giving them an estimate of time, providing resources that could be completed on a mobile phone, and providing timely check ins with each participant when required.

To be included in the study, participants had to be experienced ultra-runners and to have completed at least 2 ultra-marathons. In addition, usual weekly training outside of race, recovery or tapering weeks was expected to be over 40 miles per week, and currently training and racing. Contact was made with five professional ultra-running coaches with good international reputations and participants were recruited from their athletes. Criteria for the study was made available to all athletes and a study brief with expectations and duration of study was provided to all athletes before the study began. All athletes were advised about

ethics consent received for the study. All participants signed a standard UWTSD consent form. 45 ultra runners responded and of these, 34 took part in the study. One participant failed to complete the quiz, therefore 33 ultra runners (females: n=17; males: n=16) between the ages of 33 and 57 completed the study and were included in the final analysis.

Ethical Issues

I realised that analysing an athlete's diet is an ethical concern. Athletes with a history of eating disorders or disordered eating, poor dietary habits related to poor diet knowledge, or insufficient income to purchase good quality healthy foods. These are all examples that could cause embarrassment, concern, and distress to an athlete, as it becomes less about food and more about the mental and psychological health, education, or socio-economic status of an athlete. When constructing my original proposal, I made an early decision to screen each athlete for eating disorders.

Within the study there were no major ethical concerns. However, in my original methods for the study I included a questionnaire to screen participants for eating disorders and disordered eating. Before I submitted the study proposal, I removed this as the data was not relevant to the study and it would have required more work for me and the participants, resulting in a possible reduction in completions. On reflection, from an ethical perspective this questionnaire would be particularly valuable to help understand and deal with the difference in attitudes and understanding around food. It would have helped me better understand the psychology of the participants and alter approaches to data collection and conversations around food. A major outcome of the study was the findings that ultra-runners suffer from low energy availability, in research literature this is often associated with eating disorders and disordered eating. I also found that many participants emailed to apologise about their nutrition intakes and poor diet choices, suggesting an unhealthy relationship with how they viewed food and their own diet. From my perspective, both these issues point at athletes with psychological issues around food that may have been difficult for them, particularly when they must reflect on what they are eating and then to have it analysed. I felt this was an area that was potentially an ethical issue. With the data I have available, I also feel that ethically I should use it to help support the participants who may be suffering with low energy

availability, but do not have the knowledge or guidance to understand it. As the research had on the study, I feel I have an ethical responsibility to all the participants on the study to help them find help once I provide the data that suggests they need it. Therefore, it is ethical to uncover an issue and not help deal with it.

Ethically, some participants also looked at me for help. Participation was not just taking part in the study; it was so they could improve their knowledge and potentially improve their diet. I know feel an ethical imperative to produce additional content to ensure participants feel fulfilled and gain additional knowledge through the study.

I was aware that some participants might be on the study as they need help. Therefore, I am providing each participant with a study overview on completion, along with a food analysis and report and 30-minute consultation to discuss. This will take a large amount of editing time, but ethically this provides a reward to the participants and provides a de-brief. For all the participants who may be worried or apologetic about their diet, I can provide some support. I can also help to identify further tests and support that athletes may need to seek if they have any signs of RED-S or large nutrient deficiencies. If the study was larger, I do not feel that this would increase the ethical issues.

How knowledge was created through my research question - Outcome and Findings

Across the study, I found that knowledge was created at each step, as new data revealed new insights into the ultra-running population being studied. As I worked through the methods of data collection and analysis, I uncovered more data that both supported and refuted some of the existing research but provided novel insights into the nutrition habits and energy availability of ultra-runners. Critically, the outcome of the research does not support the literature, and one of the key assumptions that 'the reduction in energy availability from increased exercise energy expenditure is primarily driven via deficits in carbohydrate intake' (Stellingwerff et al 2021). My research question supported this, but failed to find an association that was specifically based on carbohydrates. This answers my research question, as it provides novel research that a relationship does not exist between these two variables.

My research question addressed the problem and through data collection and analysis, provided a range of outcomes and important data that both support and refute the literature that frames the research problem. My research found that ultra-runners do not meet recommended nutrition intakes, this supports the research from Blennerhassett et al (2019), and Klein et al (2021), in particular ultra-runners do not meet recommendations for carbohydrates, supporting the research from McLeman, Ratcliffe and Clifford (2019), and Beermann et al (2020). Ultra-runners do have high energy needs (Tiller 2019) and this does impact on energy availability and place them at a greater risk of RED-S, supporting the research on RED-S from Heikura, Stellingwerff, and Areta (2021), and Stenqvist, Torstveit, Faber, and Melin (2020). However, neither ultra-runners' knowledge was associated with energy availability, nor was carbohydrate responsible for this. This does not support the research from Stellingwerff et al (2020). My study found that although carbohydrates were one variable that was associated with energy availability, so were other macronutrients, such as protein. Fat was also found to have a slightly stronger relationship with energy availability than the other two macronutrients.

Conclusion

Overall, what I found was not what I expected. Reflecting on the research literature I had made the connections from the strong research that existed. However, the connections were not there. However, disappointing it may be not to find a correlation, this research opened other and bigger issues within the sport of ultra-running, as it clearly showed that ultra-runners suffer from low energy availability that may lead to performance impairments and poor health. It also supported the existing literature and added to these as ultra-runners do not meet daily recommendations for nutrient intakes, especially carbohydrates.

Words: 3202

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