What are athletes' preferences regarding nutrition education programmes?

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Science

in

Nutrition and Dietetics

Massey University, Albany

New Zealand

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2020

Abstract

Background

In elite sport, high performance is entwined with optimising nutrition. Nutrition education can improve nutrition knowledge and associated skills, enhancing the likelihood of healthy dietary behaviours in athletes. The impact of which contributes to achieving optimal performance outcomes. Currently, research in this area has largely focused on an educator-designed educational framework to achieve this goal. However, limited research exists which assesses the preferences of athletes towards their nutrition education delivery. This study aimed to explore those preferences among elite athletes in New Zealand to create an athlete-led nutrition education framework.

Methods

Elite athletes' preferences were explored through focus groups using a conceptual, deductive framework, with subsequent inductive analysis to investigate emerging themes. To achieve diversity of opinion, participants included 20 elite male (n = 5) and female (n = 15) New Zealand athletes, across various sports, aged 17 to 30 years. Focus groups were recorded and transcribed for thematic analysis of themes.

Results

Through the conceptual framework, four key areas were established for preferences: content; format; facilitator; and pedagogy. The major themes identified under content were a curriculum that educated athletes on how to integrate nutrition with training requirements, while including activities to enhance skills required for implementation. Preferences for format included a six-month programme, beginning in the off-season, with face to face interactions with the facilitator. Online preferences focused on the enhancement of communication between athletes and facilitator. The personality of the facilitator was described as someone who was non-judgmental, approachable and knowledgeable, with a preference for someone who holds a nutrition degree at minimum. Pedagogy preferences included an interactive classroom environment and the facilitator engaging in regular two-way feedback with the athletes.

Conclusion

Elite New Zealand athletes had clear preferences towards their nutrition education with regards to content, format, the facilitator and pedagogy. Nutrition education interventions should focus on athlete preferences in these areas to enhance the overall efficacy of these interventions. Further research in this area should look to gather responses from a larger group of the athletic population, applying quantitative enquiry to better develop a consensus of preferences.

Acknowledgements

I would like to pay my special regards to my supervisors, Kathryn Beck and Claire Badenhorst. I have appreciated your insights, prompt replies, and assistance with recruitment. Bevan Erueti, thank you for sharing your understanding on cultural considerations for the ethical approval of this thesis. Gary Slater, your knowledge of the athletic world has been helpful, and I know you will prove invaluable in the research to come. Janelle Gifford, what a wonderful and painstaking job you've done in the fine-tuning of this work. I am truly grateful. To my moderator assistant, Hayley Jenkins, thank you for taking the time out of a very chaotic first year of dietetics to help with my data collection. All the best for your future study. Sarah Journeaux, a big thank you for your help with booking rooms, accessing software, and all the other bits and pieces that helped bring this research together. Finally, to my classmates, especially you, Gorgeous Anna. Thanks for the last few wild years together. I hope wherever you find yourselves, you'll find a long and fulfilling career.

Abbreviations

BMI: Body mass index

NCAA: National Collegiate Athletic Association

NCP: Nutrition care process

USA: United States of America

VO_2 max: The maximum rate of oxygen consumption

P: Participant

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1 Chapter 1: Purpose

1.1 Introduction

1.1.1 Sport nutrition and importance

Nutrition is a key element in sport due to its importance in maintaining health, aiding adaptations to physical demands, and facilitating exercise performance (Jeukendrup & Gleeson, 2018). The role of nutrition becomes even more important in younger athletes as the energy demands of sport performance are compounded with the nutritional requirements for optimal growth and development (Heikkilä et al., 2019). Young adulthood also proves to be a pivotal time for the development of health promoting behaviours that will persist through life (Ashton et al., 2017). Consequently, poor nutrition leads to unfavourable outcomes in sport performance, magnifying the athlete's susceptibility to early fatigue, nutrient deficiencies, and injury risk (Simpson et al., 2017).

Despite scientific knowledge and best efforts to educate on the effects of nutrition for performance, athletes often do not meet current recommendations. It has been shown that while athletes understand the benefits of a nutritious diet, their actions often do not reflect this (Madrigal et al., 2016). Due to the frequently heightened requirements and lower than desired adherence to nutrition information, the need for efficacious nutrition education programmes becomes paramount to improve daily food choices (Heikkilä et al., 2019).

1.1.2 Nutrition education and efficacy

The basic premise of a nutrition education programme is that through increasing the nutrition knowledge of athletes, they will then implement this knowledge into their lives, improving dietary intake leading to better health and greater sports performance (Spronk et al., 2015). Previous programmes have been shown to improve nutrition knowledge significantly after only three education sessions, yet alterations in diet quality and eating patterns may only be minor (Heikkilä et al., 2019). Similarly, phone application-based interventions created significant improvements in nutrition knowledge in elite New Zealand athletes when provided with a weekly fact sheet based on current best practice in sports nutrition (Simpson et al., 2017). A recent systematic review of the impact of nutrition education on athletes'

nutrition knowledge has shown that although it is well established that nutrition education programmes improve the nutrition knowledge of athletes, given the heterogeneity of education delivery across studies means that best practice is hard to discern. (Tam et al., 2019).

1.1.3 Athlete preferences for nutrition education

Little research has been undertaken regarding athlete preferences for nutrition education. Research into phone use for nutrition education, particularly through social media, identified that peer support and interaction, as well as an authentic delivery and personalised description of nutrition information was more favourable among New Zealand athletes (Bourke et al., 2019). Social media has also been described as an effective medium for rapid communication, providing behavioural prompts, and delivering nutrition education in an efficient and easily accessible manner for athletes (Dunne et al., 2019).

Studies exploring nutrition related behaviours in other avenues found that having access to a sports dietitian enhanced nutrition knowledge which translated into a positive improvement in energy and macronutrient intake, better reflecting the requirements for optimal performance (Hull et al., 2016; Valliant et al., 2012). Australian athletes have shown a preference for a sports dietitian, while also valuing the internet and nutritionist as preferred sources of information (Trakman et al., 2019). Research in other populations also suggests face to face nutrition education with complementary online and phone application-based learning may be acceptable (Ashton et al., 2017).

1.1.4 Factors to consider regarding nutrition education for athletes

Although athletes may have a good understanding of general nutrition knowledge, there remains a lack of understanding of best performance nutrition and a difficulty when applying this knowledge into consistent dietary habits (Hull et al., 2016). This is partially due to certain factors in an athlete's life which need to be considered to enhance nutrition adherence (Bentley et al., 2019).

One factor contributing to suboptimal nutrition adherence is the culture within the sporting environment. Generally, performance goals dominate the field, where nutrition education and diet implementation need to be designed to accommodate periods of maximum physical demand (Bentley et al., 2019). The consequence of this is a deviation of athletes' diets in response to wavering performance demands during the season (Bentley et al., 2019). This has

been shown in National College Athletic Association athletes within the United States, where nutrition quality dramatically declined in the off-season (Hull et al., 2016). Similarly, New Zealand adolescent male rugby players have shown increased motivation to meet nutrition requirements for performance, particularly around game day, yet express a decline in this motivation after the season or during injury (Stokes et al., 2018).

Additional barriers derived from the sporting environment include role conflict in nutrition education delivery, a lack of accountability and self-monitoring in athletes, and tight time constraints for nutrition-based practitioners to educate their athletes (Bentley et al., 2019). Although sporting coaches often have an insufficient nutrition knowledge base, athletes continue to obtain nutrition information from this and other sources, leading to a potential for misinformation and subsequent impacts on health and performance (Heikkilä et al., 2019; Hull et al., 2016). Athletes also face the same challenges as other young adults in implementing dietary change including factors such as starting and completing further education, beginning employment or unemployment, co-habiting with peers or a partner, getting married and/or becoming a parent (Ashton et al., 2017).

Given that cell phone, social media, and internet use are common in today's climate, there has been a shift towards these modalities for nutrition education. Results from a cross-sectional study conducted in New Zealand found that 65% of athletes had used social media for nutrition purposes over a twelve-month period, mainly utilising recipes, practical food ideas, weight loss/maintenance advice, protein needs, and several other nutrition-related topics (Bourke et al., 2019). This also highlights a potential deficit in nutrition education delivery, as many traditional methods of nutrition education do not target the building of self-efficacy within athletes, inhibiting any positive behavioural changes. A proposed focus in the same vein is that the food skills; planning, shopping, and budgeting are largely neglected in education, yet may be of greater importance to diet quality (Lavelle et al., 2019).

Although nutrition education can be effective for athletes, deficits in dietary behaviours still exist. The question then arises as to 'what is best practice for implementing nutrition education to ensure positive behavioural change is both made and sustained'. A seemingly rational approach is to develop best practice through the desires of the athletes receiving it. Past research on preferences for nutrition education programmes from participants outside of the athlete sphere have provided a sense of direction for future implementation among the respective population (Ashton et al., 2017), yet sparse literature exists for what athletes want

specifically regarding nutritional education. Therefore, this study looks to collaborate with athletes to identify best practice for nutrition education programmes.

1.2 Aims and objectives

A: To collaborate with elite New Zealand athletes to identify their preferences for nutrition education programmes.

O: To determine athletes' desired format parameters of a nutrition education programme including length, frequency, class size and make-up, and delivery method, with a focus on online delivery.

O: To identify the specific content to include in a nutrition education programme as preferred by athletes.

O: To develop athlete-guided attributes for their ideal facilitator, including personality, number, type, qualifications, and experience.

O: To further understand athletes' preferences for pedagogy, including goal setting and monitoring; feedback and support; and engagement and enjoyment.

1.3 Researcher contributions

Name	Contribution
Matson McCauley	Primary researcher. Second year dietetics student. Undertook ethics application, participant recruitment, focus groups as main moderator, qualitative data analysis and codebook creation/re-creation, and thesis creation as per partial fulfilment of a master's degree in nutrition and dietetics.
Hayley Jenkins	First year dietetics student. Assisted in recruitment and acted as moderator assistant for the focus groups.
Associate Professor Kathryn Beck	Main supervisor and conceptualised the study. Assisted in recruitment, ethics application, focus group questions, literature review direction, qualitative data analysis and codebook re-creation. Provided review and feedback on all documentation provided by the primary researcher in preparation for thesis submission.
Dr Claire Badenhorst	Co-supervisor. Assisted in recruitment, focus group questions, literature review direction, qualitative data analysis and codebook re-creation. Provided review and feedback on all documentation provided by the primary researcher in preparation for thesis submission.
Dr Bevan Erueti	Provided information for finalising the ethics application with a focus on upholding the special considerations around the Treaty of Waitangi.
Associate Professor Gary Slater	Provided feedback for focus group questions and important areas of literature.
Dr Janelle Gifford	Co-supervisor. Provided advice on the qualitative design and aspects of analysis. Assisted the primary researcher in ensuring qualitative rigour. Reviewed thesis for submission.

2 Chapter 2: Literature Review

2.1 Introduction

This review begins with developing the basis for why nutrition is crucial within sport. It then explores the athletic environment, illustrating dietary practice and current levels of nutrition knowledge among athletes, and their association. Also included is the effectiveness of nutrition education programmes, focussing on their ability to improve nutrition knowledge, as well as emerging educational modalities and their relative success. A further aspect of the athletic environment reviewed is the current sources of nutrition information most chosen by athletes, with a focus on the predominant online resources.

Underlying lifestyle considerations from the literature are discussed, highlighting the most prominent enablers and barriers in athletes' lives that need to be accounted for to provide a higher opportunity for the success of the nutrition education programme. Finally, this review looks at research that utilises participant guided educational frameworks, including research that assesses athlete and non-athlete populations.

2.2 The importance of nutrition in sport

Nutrition plays not only an integral part in maintaining health but becomes essential in an athletic environment to facilitate adaptations to training for a sport (Jeukendrup & Gleeson, 2018). Given that nutrition quality impacts nearly all bodily processes of energy production, nutritional adequacy must be assured to maintain athletic performance (Jeukendrup & Gleeson, 2018). This need for adequacy is not limited to improving athletic performance while on the field, as nutrition's influence contributes to adaptations off field, promoting muscle growth, recovery, and rehabilitation (Debnath et al., 2019). Although optimising nutrition remains a constant goal, specific nutritional requirements will fluctuate in accordance with the expectations of the athlete and time/training period of the athletic year. This is particularly relevant during periods of competition, where the need for performance is at its highest, therefore optimising nutrition strategies becomes a cornerstone not simply for the prevention of physical fatigue but to also maintain the mental resilience of athletes while undergoing rigorous activity (Thomas et al., 2016). Realistically speaking, optimal nutrition manifests as positive food-related behaviours and dietary practices. In this sense, appropriate food and fluid choices equate to continual performance through conducive macro- and

micronutrient composition, adequate hydration, and overall energy intake, improving subsequent training sessions and post-training recovery (Shriver et., 2013).

A position statement from the Academy of Nutrition and Dietetics states that achieving an appropriate energy intake is the foundation for sport nutrition as it promotes performance, determines total nutrient requirements, and aids in developing beneficial body composition (Thomas et al., 2016). When this is not adhered to, particularly regarding energy from carbohydrate intake, training intensity and duration may become hampered (Burke et al., 2011; Thomas et al., 2016). Carbohydrates provide the main energy source in the athlete diet, providing the most metabolically efficient substrates and better facilitating high-energy demands when compared with energy from fat. In the absence of sufficient carbohydrates, athletes suffer from impaired work rates, reduced concentration, and increased fatigue (Thomas et al., 2016). This is supported by a review paper which shows across several studies that low energy availability is often reported occurring in those with a low carbohydrate diet and this lack of energy is consistently associated with poorer sports performance (Logue et al., 2018). Other associated consequences see athletes suffering potential metabolic abnormalities, unwanted muscle mass loss with an increase in fat mass, greater susceptibility to injury, impeded adaptation capacity, and an extended recovery window (Blennerhasset et al., 2019; Thomas et al., 2016). One study in swimmers showed a decrease in performance by 9.8% within the low energy availability group in contrast to an 8.2% increase in performance in athletes who maintained adequate energy availability (VanHeest et al., 2014).

Further concern and importance are given to nutritional adequacy in sport when dealing with adolescent athletes. This is due to the demands of sports performance being compounded with the nutritional requirements for optimal growth and development for this age group (Heikkilä et al., 2019). This already complex relationship is complicated further by the heterogeneous timing of pubertal maturation in adolescent athletes and attempting to match energy intake accordingly (Desbrow et al., 2014). Since nutrition quality is determined by food-related behaviours and dietary practices, adolescence proves to be a significant life stage in which to develop long-term health promoting nutritional behaviours (Ashton et al., 2017).

2.3 Dietary practices of athletes

A recent systematic review of nutritional quality across 21 studies in professional and semi-professional athletes from varying team sports and countries demonstrated an overall dietary inadequacy to meet the demands across sports (Jenner et al., 2019). The results suggest a mismatch in macronutrient composition, showing a displacement of carbohydrates for higher intakes of fat and protein (Jenner et al., 2019). Qualitative inquiry would suggest that although athletes may understand the importance and associated benefits of adequate nutrition, certain influences cause their diets to not reflect this understanding, with their diets often being inadequate not only for their sport performance needs, but also those recommendations set for the general public (Madrigal et al., 2016). Other examples of this are shown in studies highlighting inadequate hydration for training (Judge et al., 2016) and calcium intakes not meeting non-sport specific estimated average requirements (Raizel et al., 2017).

Of the studies reported by Jenner et al. (2019), 16 reported protein and fat intake in excess of sport nutrition recommendations. Results across athletes competing in Australian football, rugby league, and rugby union showed an intake of more than two grams of protein per kilogram of bodyweight, per day (g/kg/day) with one study reporting an average of 3.4 g/kg/day among Australian professional football athletes (Devlin et al., 2017; Jenner et al., 2019). These protein intakes far exceed the sports nutrition recommendation of 1.2-2 g/kg/day (Thomas et al., 2016). The associated general tendency was for these high protein and fat diets to nevertheless be hypocaloric, thus lacking adequate energy for optimal performance (Jenner et al., 2019). Conversely, another study conducted within certain athletic populations in India suggests that insufficient protein intake is one of several nutritional inadequacies (Debnath et al., 2019). Several studies assessing nutrition and diet quality among athletes from the National Collegiate Athletic Association (NCAA) found athlete diets were high in saturated fat, total fat, cholesterol, and sodium, while being low in polyunsaturated fatty acids, and fibre (Abbey et al., 2017; Rash et al., 2008; Webber et al., 2015). Similar results were observed in Australian adolescent rugby union players who failed to meet daily fruit and vegetable intake, while indulging in treat foods in excess of guidelines (Burrows et al., 2016). Other research in Australian athletes has shown an additional failure to achieve basic dietary recommendations, particularly foods from the dairy category (Heaney et al., 2010; Spronk et al., 2015).

Recommendations suggest 6-10g carbohydrate/kg/day for moderate to high intensity exercise (Abbey et al., 2017; Burke et al., 2011; Jenner et al., 2019; Valliant et al., 2012). Research in Australian adolescent rugby players shows intake to fall short of the lower end of carbohydrate recommendation for facilitating continual sport performance (Burrows et al., 2016; Heaney et al., 2011). From the 17 studies which included data for carbohydrate intake, Jenner et al. (2019) showed that 15 showed low intake, and failure to meet the International Society of Sports Nutrition's more conservative recommendation of 5-8g/kg/day. Studies in NCAA athletes echoed these data, stating that across a number of athletic disciplines, nearly all had inadequate or low adherence to energy and carbohydrate intakes, even when compared with the minimum recommendations for sport nutrition (Abbey et al., 2017; Shriver et al., 2013; Valliant et al., 2012). It would appear there is some degree of carbohydrate periodisation within certain sporting groups, increasing intake for competition days and reducing intake for training days (Jenner et al., 2019). Sport nutrition recommendations are even more unlikely to be achieved during the off-season in the athletic year. Work from Valliant et al. (2012) showed that among NCAA female volleyball players, the average carbohydrate intake during the off-season was only 48% of estimated needs. When questioned on the topic of how athletes vary their intake over the off-season, a group of sports registered dietitians/nutritionists noted the liberalising of the diet, increasing portion size and intake of treat food, alcohol and sweets (Eck & Byrd-Bredbenner, 2019). Food preferences appear to change during the off-season, where they are guided by taste and preference, as compared to eating for performance during competition.

Despite the importance of energy for sport performance, numerous studies report the hypocaloric state of the athlete diet. From the studies reviewed by Jenner et al. (2019), nine of fourteen reported energy intakes not meeting required ranges for training days. Related results were seen by Hassapidou and Manstrantoni (2001), where four teams of women athletes from Greece were not in energy balance at any point during their athletic year, with macro and micronutrient intakes not dissimilar to the non-athletic control group, despite the athletes having a far greater energy requirement. Analysis of off-season energy intake of female NCAA athletes in the United States of America (USA), showed an average of 56% of estimated needs, which were calculated at 37-41 kilocalories per kilogram of body weight (Valliant et al., 2012). These results suggest that the importance of sports nutrition alone is not enough to drive athletes to improve their nutrition knowledge and eating habits.

2.4 Nutrition knowledge and dietary practices of athletes

2.4.1 Nutrition knowledge of athletes

Research addressing the nutrition knowledge of athletes suggest that perhaps there are some gaps in the nutrition knowledge of athletes. This results in athletes' nutrition knowledge scores being significantly higher for a small number of questions, yet overall suboptimal for both sports specific and general nutrition questions (Zawila et al., 2003). A potential consequence of forgoing a solid foundation from the recommendations for healthy eating may lead to an overall low-quality diet. A systematic review of 29 studies assessing the nutrition knowledge of athletes showed that 19 studies, in the absence of non-athlete comparison groups, yielded mean nutrition knowledge scores of 50-70% (Heaney et al., 2011). When assessing seven studies comparing athletes' nutrition knowledge to that of a non-athlete comparison group, most studies (n = 5) showed athletes' mean scores for nutritional knowledge were greater than 50% which either matched or exceeded the scores of the associated non-athlete control groups with the exception of nutrition students (n = 2) (Heaney et al., 2011). A more recent systematic review by Trakman et al. (2016) assessed 36 studies on athletes' nutrition knowledge. These athletes were mixed gender, from multiple sporting disciplines, and studies were predominantly conducted in the United States. No difference was found when analysing differences in nutrition knowledge between the genders or between sports (Trakman, et al., 2016). Reports on nutrient knowledge showed that less than 30% of athletes knew the energy density of macronutrients and less the 50% could identify food sources for specific nutrients (Trakman et al., 2016). Answers to questions on micronutrient knowledge were diverse, with some studies reporting correct answers in excess of 70%, with others scoring below 50%. A common misconception reported was the need for supplementation, with over 40% of athletes believing that protein, as well as vitamin and mineral supplements are necessary to optimise athletic performance and recovery (Trakman et al., 2016). Another study found that athletes with prior tertiary education in nutrition or health tend to have significantly higher nutrition knowledge scores than those who have received no previous education (Abbey et al., 2017).

Other results highlight a knowledge difference through the professional hierarchy of athletes, where elite athletes score higher on nutrition knowledge tests than recreational athletes and likewise, tertiary level athletes have been shown to outperform those competing at a secondary school level (Heaney et al., 2011). In contrast, a study in Australian elite and non-

elite athletes showed no significant increase in knowledge in those athletes who had had previous sport dietetic input, while also finding no difference in nutrition knowledge between elite and non-elite athletes (Trakman et al., 2019). One study assessing sports nutrition knowledge revealed that NCAA female volleyball players were least knowledgeable in questions relating to weight control, dietary supplements, and general nutrition, with over half of the athletes answering incorrectly in these areas (Valliant et al., 2012). A similar study looking into the nutrition knowledge and practise of 90 male football and hockey players from India showed limited understanding of carbohydrate and fibre digestion, vitamin supplementation, and the functions of iron in the diet (Debnath et al., 2019).

2.4.2 Nutrition knowledge and dietary practices of athletes: what is the link?

When assessing nutrition knowledge and nutrition practitioner accessibility, studies conducted in the U.S.A showed that access to a sport dietitian improved knowledge which translated into improvement in dietary practice, enhancing energy and macronutrient intake for maximising performance (Hull et al., 2016; Valliant et al., 2012). Debnath et al. (2019) found those athletes with greater nutrition knowledge had better associated dietary practices which resulted in greater energy and nutrient intake that was positively correlated to higher levels of maximum rate of oxygen consumption (VO_2 max), basal metabolic rate, and muscle mass. This suggests overall greater athletic performance and body composition in those athletes with greater sport nutrition knowledge and dietary practice.

Although athletes tend to have a basic understanding of nutrition knowledge, be it sport specific or general, there appears to be some disconnect between that knowledge and its application to dietary practices. Studies assessing this association in college track athletes have reported moderate knowledge regarding nutrients in exercise, albeit with some knowledge gaps, yet when related to dietary quality, knowledge contributed to less than 1% of the ability to predict dietary practice (Rash et al., 2008). This finding is reproduced across studies, suggesting a reasonable level of knowledge in combination with poor interpretation and an inability to apply this knowledge into consistent eating behaviours. In older systematic reviews on this topic, it appears that nutrition knowledge may have a slightly positive impact on dietary practices among athletes, although most correlations are weak (Heaney et al., 2011; Spronk et al., 2014). In a newly published systematic review on this link, Boidin et al. (2020) found similar inconsistencies across 22 studies (single arm $n = 12$, double arm $n = 10$) of athletes aged 12 to 65 participating in nutrition education programmes. Of the studies

analysed, 14 found a significant change in one or more nutrition parameters, yet dietary change remained inconsistent (Boidin et al., 2020). Moreover, study results differed in their direction and magnitude when assessing effect size, consistency of dietary change, and significance of change (Boidin et al., 2020). Of concern, where assessed, post-intervention carbohydrate intake remained inadequate in comparison to recommended guidelines (>50% energy requirements/6-10 grams per kg per day).

Within the elite sporting environment, all knowledge and skills afforded to the athlete are done so to maximise their sporting prowess. Yet the fact remains that not only do elite athletes have gaps in nutrition knowledge, both sport specific and general, but they also show inadequate application of this knowledge to their dietary intake, which may lead to poorer performance and suggests certain limitations of current nutrition education in the sporting environment (Tam et al., 2019). In participants outside the athletic sphere, research has shown that nutrition education may not be targeted at knowledge gaps, such as the basic skills required to implement healthy eating, potentially maintaining the gap between knowledge and practice (Ashton et al., 2017).

2.5 The effectiveness of nutrition education programmes

Whilst still requiring further study in the athletic community, the work of Murimi et al. (2017) has identified key characteristics of nutrition education programmes that achieve success across non-athletic participants of varying descriptions. The systematic review identified 40 manuscripts published between 2009 to 2015 and identified the following key characteristics: programme duration longer than five months; three or fewer focused and related objectives; based on learning theories; and a level of fidelity in delivery, meaning the programme activities are executed in accordance to the methods (Murimi et al., 2017).

Through the recent work undertaken by Boidin et al. (2020), the effectiveness of nutrition education programmes on improving athletes' dietary practices has been hard to discern. The inability to draw comparisons between studies was predicated on the heterogeneity of their design, varying in modality, duration, diet assessment methodology, intervention and control comparisons, facilitator qualification, and the lack of reporting of pertinent study information (Boidin et al., 2020). Similar conclusions have been found elsewhere, where methodology between studies has been complicated by partially validated assessment tools and large variability in research modalities (Heaney et al., 2011; Trakman et al., 2016). The consequence is that it is nearly impossible to make any decisive claims about best practice for

nutrition education programmes and their ability to improve dietary intake. Included in the work of Boidin et al. (2020) is a checklist which provides guidance for future nutrition education research, offering considerations for improved study design and reporting. Adherence to this checklist by future research would not only provide robust methodology for nutrition education research, but also create uniformity in reporting, allowing the identification of best practice for improving athletes' dietary practices.

Although practical, skills-based approaches such as supermarket tours are underutilised, they may be more efficacious as they are show high acceptability by participants, enhance personal agency, and provide enjoyment while learning (Tam et al., 2019). A systematic review of studies using non-athletic participants showed that the use of supermarket tours for nutrition education created positive health-related outcomes and nutrition knowledge retention up to three months, yet the appropriate frequency, duration, and topics to instil behavioural change are yet to be discovered (Nikolaus et al., 2016).

With the implementation of nutrition education programmes for athletes there is the expectation that an increase in dietary or nutrition knowledge, translates to an improvement in continual positive dietary practices which enhance on-field performance (Spronk et al., 2015). These programmes also look to correct certain negative aspects of the athlete's diet through improving nutrition knowledge in general terms and specifically for sport (Heaney et al., 2011). Recent results from a systematic review by Tam et al. (2019) investigating the effect of nutrition education interventions on improving nutrition knowledge show that despite a range of different modalities and differences in other variables, 27 out of 32 studies reported a significant improvement in nutrition knowledge. Through this review it is also possible to draw inferences as to which modalities are more beneficial for improving nutrition knowledge. Nutrition information handouts appear to be the least effective modality, yet when given in conjunction with a cooking class or presentation by an engaging facilitator, knowledge retention tends to increase (Tam et al., 2019). Group education was also shown to be as effective as individual counselling, incorporating not only the best interests of the athletes through active learning with peers, but also providing the organisation with a viable, cost effective method (Tam et al., 2019). This method of delivery is especially beneficial for those organisations with limited staffing and funding (Tam et al., 2019). A recent study identified that within 79 Finnish endurance athletes, when comparing traditional, didactic style nutrition education to nutrition education with an additional phone application element, there was significant improvement in nutrition knowledge within both groups following just

three educational sessions, yet this was not attributable to the inclusion of the phone application (Heikkilä et al., 2019). However, the increase in nutrition knowledge was insufficient to improve dietary behaviour (Heikkilä et al., 2019), similar to what has been observed in non-athletic populations taking part in shorter nutrition education programmes (Murimi et al., 2017).

When referring to nutrition education programmes in a more traditional, group education setting, this is potentially limited to nutrition facts or a static understanding of nutrition, not necessarily translating into ability or practical skills resulting in the athlete being unable to select healthy options, prepare those options, or understand food labelling (Spronk et al., 2014). This reinforces the need to ensure that athletes are eating in accordance with best nutrition practice by including the assessment of both dietary patterns and food variety (Spronk et al., 2015). It also highlights that the current provision of nutrition education lacks a certain degree of personalisation, applicability, and relevance to the athlete, possibly hindering overall retention. One study in NCAA division one American football players hints at these deficiencies in which athletes who received formal nutrition education through a lecture format actually fared worse in terms of nutrition knowledge than the control group who received no nutrition education (Judge et al., 2016).

Current limitations in education call for an alternative approach to enhancing nutrition knowledge in athletes. A proposed focus is to reorient education to improve nutrition literacy, which can be defined as 'the degree to which individuals have the capacity to obtain, process, and understand nutrition information and skills needed in order to make appropriate nutrition decisions' (Zoellner et al., 2009). In much the same way as health literacy, acquiring an adequate level of nutrition literacy allows the athlete to take full advantage of verbal and written nutrition information and then act in their best interest for optimising athletic performance (Spronk et al., 2014). Improving nutrition literacy means possessing nutrition knowledge and skills which hold relevance, enable, and are personalised to the athlete's dietary choices (Spronk et al., 2014). To accommodate this focus for nutrition education, it has been suggested to apply more innovative strategies, combining the appropriate skills and knowledge with solutions to facilitate behaviour modification and address barriers to eating well (Spronk et al., 2015). Cooking classes, technology-based platforms, and supermarket tours are just a few examples of the currently underutilised and novel approaches to improving nutrition literacy and minimising barriers and should be considered to improve the effectiveness of future programmes (Tam et al., 2019).

2.6 Athletes sources of nutrition information

Results from 410 Australian athletes have yielded first choice preferences for nutrition information from a sports dietitian (20%), online nutrition education (19%), nutritionist (16%), athletic trainer (14%), or family/friend (10%) (Trakman et al., 2019). This contrasts with the results from studies conducted in the U.S.A investigating where athletes actually receive nutrition information from. The data suggest NCAA athletes receive their nutrition information from their coach (25%) more so than a sport dietitian (6%) (Abbey et al., 2017), and may be more comfortable with seeking advice from an athletic trainer or coach as opposed to consulting with a sport dietitian or nutritionist (Abbey et al., 2017; Judge et al., 2016). Worryingly, recent research has shown that although athletic trainers provide nutrition advice, they lack the sufficient nutrition knowledge to do so, particularly in diet-disease relationships (McKean et al., 2019). Parents and friends were also reported to be a preferred source of nutrition information (Zuniga et al., 2017). Other reported, yet less utilised sources for nutrition information were doctors, academic journals, magazines, mass media, and teammates (Abbey et al., 2017; Trakman et al., 2019).

A potential cause of this is insufficient access to a nutrition practitioner due to the stretching of nutrition services as practitioners contend with competing priorities across the athletic environment (Bentley et al., 2019). The tendency then is to consult those staff members with whom the athlete interacts with the most, predominantly trusting in the athletic trainers for their nutrition advice (Abbey et al., 2017). This is reflected in studies on athlete preferences, showing the athletic trainer to be accessed more than the dietitian for nutrition information (Folasire et al., 2015). Although elite athletes are more likely to receive advice from a dietitian (Trakman et al., 2019), nutrition education programmes may remain coach directed (Heaney et al., 2011). As the nutrition practitioner trained at a high level and is accredited by professional organisations, their absence leaves the athlete in a potentially vulnerable position (Tam et al., 2019).

2.6.1 Athletes use of online sources of education

Online education programmes are cost-effective tools which enable the education provider greater reach and education choices, and are easily accessible (Bensley et al., 2011; Lohse, 2013). Outside of an athletic domain, work by Bensley et al. (2011) compared the impact of online nutrition education with a traditional nutrition education modality (group nutrition

education class), among mothers and caregivers enrolled in a special supplemental nutrition programme in the U.S.A. Findings showed that not only did participants find the education useful and satisfactory; the programme incited steps towards behaviour change at a greater rate than the traditional education programme, and retention of nutrition information was maintained, leading to more frequent self-reports of behaviour change (Bensley et al., 2011). These results are in agreement with qualitative work performed among young and middle-aged Australian men, finding overall, a delivery preference for online nutrition education as a means to improve nutrition knowledge and enhance dietary behaviours (Abbey et al., 2017; Vandelanotte et al., 2013).

Given that internet access and the owning of a smartphone are commonplace among athletes, the incorporation of an online aspect into nutrition education by sport nutrition practitioners to improve their overall delivery is advisable, given their effectiveness for communication and accessibility for staff and athletes (Ahmed et al., 2015; Dunne et al., 2019). Quantitative results from 44 sports nutritionists from the U.K. and Ireland, found 39 were using social media for the delivery of nutrition information, either instead of or in conjunction with more traditional education modalities (Dunne et al., 2019). The specific smartphone applications and social media platforms most reported as education tools were WhatsApp, Facebook, and Twitter, with the education provided predominately being recipes, nutrition facts, or nutrition plans, delivered via picture or infographics, videos less than 30 seconds long, or videos lasting between 30 and 90 seconds (Dunne et al., 2019). The qualitative aspect of this study highlighted the positive perceptions of social media use among sports nutritionists, stating benefits such as providing quick updates, prompting or nudging, and the preference and acceptability of WhatsApp notifications compared to traditional e-mail contact (Dunne et al., 2019).

An earlier multi-national cross-sectional study investigating smartphone application use among sports dietitians found nearly one third of participants were using these applications, finding them particularly useful for athlete self-monitoring and allowing better dietary tracking (Jospe et al., 2015). Of the applications used, MyFitnessPal was shown to be the most popular among sports dietitians (Jospe et al., 2015). Perceived limitations from qualitative work among sports specific and general dietitians suggests that while commercial phone applications remain currently without adequate validation, food databases and incorrect user entry present as prominent issues (Jospe et al., 2015; Lieffers et al., 2014). In

athletes, the social media sites, Facebook and YouTube were reported to have been used as educational tools by 97% and 60% of athletes respectively (Maloney et al., 2014).

Research investigating the prevalence of social media use across 306 New Zealand elite and non-elite athletes found over half had used social media in the last 12 months for nutrition or dietary purposes, mainly for recipes, identifying appropriate protein needs, and weight loss or maintenance (Bourke et al., 2019). Within this same group, female and non-elite athletes were more likely to use social media for nutrition information (Bourke et al., 2019). Athlete responses to questions on preference showed that social media offers well presented, easily accessible information, while also allowing convenient synthesis of extensive amounts of nutrition information (Bourke et al., 2019). Perceived negative aspects among some athletes regarding social media as nutrition resource were a lack of reliability and dull or irrelevant information (Bourke et al., 2019). Investigation into the utilisation of online nutrition information and social media among adolescent male rugby union players in New Zealand showed a tendency to follow athletic role models on social media, mimicking their dietary practices and training routines (Stokes et al., 2018)

Despite rising popularity, online or application based educational tools are still under-researched in the athletic community. However, results from a recent systematic review show a greater rate of athlete usage and commitment compared to previous years, combined with significant improvements in nutrition knowledge (Tam et al., 2019). Nutrition knowledge and its translation to behaviour change is best when online interventions are both interactive and delivered concomitantly with other modalities that are not necessarily online in nature (Buffington et al., 2016; DuBose, 2012; Karpinski et al., 2012; Simpson et al., 2017). One study in particular which investigated the efficacy of an application based intervention among elite New Zealand athletes yielded a vast improvement in nutrition knowledge through the provision of a weekly app-based sports nutrition fact sheet and video, along with individualised sport dietitian feedback delivered through the same application (Simpson et al., 2017). The inclusion of a weekly nutrition fact sheet and video is in line with research among division one, NCAA athletes stating a high probability of using a nutrition education application tool (Zuniga et al., 2017). This population preferred nutrition topics such as protein, hydration, and fuelling during exercise, over certain features such as food logging (Zuniga et al., 2017). Another positive element reported by athletes was the use of social media as a means of interaction with team members and other athletes, facilitating further

support, the sharing of information, and a better chance for sport nutrition to have a greater focus in relation to sport performance (Simpson et al., 2017).

Although online platforms provide the majority and most easily accessible resources for nutrition information, there are many other areas where athletes turn for guidance. Education delivered verbally can come from a number of different providers, ranging from family, coaches, and athletic trainers to sport scientists and medical practitioners, not least exclusively from dietitians and nutritionists (Abbey et al., 2017; Heaney et al., 2011; Trakman et al., 2019).

2.7 Factors to consider in nutrition education programmes for athletes

Despite the athlete's level of nutrition literacy being a critical determinant in driving dietary intake for athletic performance, this is just one element in the translation of knowledge and ability to action. The link between the inputs and desired outputs is a complex one, incorporating various barriers or enablers, which will be impactful on the preferences of athletes in relation to their nutrition education programme.

One example is that, although athletes understand the benefits of nutrition counselling, many are not provided such access (Debnath et al., 2019). In these instances, other athletic staff serve as the first line in the identification and correction of nutritional inadequacies, yet are often not suitably qualified to do so (Folasire et al., 2015; Heikkilä et al., 2019; Judge et al., 2016; McKean et al., 2019; Trakman et al., 2019; Zawila et al., 2003). An additional factor to consider is that time is a precious yet finite commodity during the competitive season, meaning prioritisation needs to be given to those sporting goals deemed most important. In most cases these are performance goals, which then dictate motivation toward nutrition goals (Bentley et al., 2019). Nutrition practitioners report that consultation time with the athlete may be insufficient to address nutrition concerns and plan adherence; ultimately the athlete may not have the capacity to reach their full performance potential. (Bentley et al., 2019). Another common factor influencing the general population and athletes alike is balancing training requirements in day to day living (Ashton et al., 2017; Tam et al., 2019). These elements may include life changes specific to the life-stage, travel associated with sporting commitments, other extracurricular activities, intensive academic schedules, paid employment, and a lack of anticipatory meal preparation (Ashton et al., 2017; Heaney et al., 2011; Tam et al., 2019). What tends to occur because of these commitments and time

constraints is athletes opting for food that is convenient, even if unhealthy, and this is especially true when combined with a reported lack of energy (Stokes et al., 2018).

The impact of these factors may influence athletes' desires for different modalities of nutrition education. Research into the effectiveness of various modalities emphasises that some are better than others and a multiple modality approach is potentially more effective than a singular approach (Tam et al., 2019), particularly when providing the athlete flexibility for nutrition education engagement under such time constraints.

A common factor in the literature is a reported decline in athletes' nutritional quality while injured and during the off-season, often seen in conjunction with a drop in motivation as their physical requirements are not so stringent as within season (Stokes et al., 2018; Valliant et al., 2012). Even during the season there appears to be a deviation from best practice through the altering determinants of food choices. Often seen is the decline in optimal nutrition in response to the fluctuating goals of the athletic period, where food choices and hydration status depend on the stringency of the current athletic commitments (Blennerhasset et al., 2019; Judge et al., 2016).

Research investigating negative cultures in athletes outside the nutrition sphere reveals the potential for sporting cultures where the coach's temperament was intimidating to the point of athletes simply not sharing concerns (Orlick & Partington, 1987) or athletes only engaging in a behaviour if it was deemed acceptable by the team coach, as a way to gain approval (Baugh et al., 2014; Kroshus & Baugh, 2016). Within the nutrition sphere, the idea of devolved responsibility has also been proposed, suggesting a tendency and sporting culture in which everything is done for the athletes, inhibiting the development of the skills and motivation required to implement and maintain a positive behavioural change in response to nutrition education (Bentley et al., 2019). A separate yet no less damaging aspect of certain sporting cultures is role conflict, in which sports staff external to the discipline of nutrition think it suitable to provide athletes with nutrition and dietary advice (Bentley et al., 2019). This action may lead to the delivery of dubious advice, creating misconceptions and the possibility of risking athlete health and performance (Bentley et al., 2019).

In the athletes' personal lives, friends and family can present as a barrier to nutritional adherence. As an athlete is much more likely to spend more time with friends and family (Trakman et al., 2019), this tends to subject the athlete to the beliefs and tendencies of those

around them (Heaney et al., 2011). An aspect of family commitments ties into the barrier of food availability, where the athlete will eat what the family eats. Food availability has also been shown to negatively impact athletes when they have their food prepared for them, lacking the motivation to acquire further nutritional knowledge and skills (Zawila et al., 2003). Similarly, friendships can negatively affect dietary choices, as those non-athletic or even athletic peers can create temptation to eat unhealthily through example (Stokes et al., 2018).

In terms of education facilitators, given that research shows that athletes sometimes have a closer connection to their athletic trainers and coaches and are more comfortable receiving advice from them (Abbey et al., 2017), there may be a preference for these staff to provide the nutrition education programme, either in full or in conjunction with the nutrition practitioner.

Misconceptions in the realm of nutrition tend to lead to misinformed behaviours in relation to general health and sport performance. A common misconception is that although they are less healthy, discretionary foods provide a cheaper option than healthier alternatives (Stokes et al., 2018). Similarly, although presenting as a viable modality for the delivery of nutrition education, social media brings forth myths and misconceptions, seemingly compelling on the surface, but incorrect and inappropriate in reality (Ahmed et al., 2015; Heaney et al., 2011). These factors emphasise the need for nutrition education programmes that aim to debunk such misconceptions as well as address issues like meal skipping and the limited cooking skills of athletes (Webber et al., 2015).

Because of these influences, athletes may desire relevant content that targets contemporary nutrition topics and areas of confusion in their nutrition education. More practical, skills-based content has also been suggested as an alternative approach, rather than simple nutrition facts for improving dietary behaviours (Tam et al., 2019). Recent research has referred to improving nutrition skills in meal planning, shopping, and budgeting, in order to provide a holistic approach to meal preparation and diet quality, solidifying nutrition literacy and strengthening autonomy (Lavelle et al., 2019). As athletes know their lives better than anyone else, allowing their input into their own education is a way to factor in preferences where all the barriers and conditions have been automatically considered and circumvented.

2.8 Participant/athlete guided education frameworks

Research into the development of educational frameworks as guided by the participants it is designed for, is not a novel idea. The success and general premise of a participant guided approach is that through a deeper understanding of the wants, needs, and preferences of a group, the framework is better informed in regard to its creation and application, while accommodating the most effective way to translate desired health targets into realistic lifestyle behaviours (Ashton et al., 2017; Morgan et al., 2016). Based on the model by Morgan et al. (2016), the interventions effectiveness becomes optimised by identifying the demographic's intervention preferences across four areas: content; format; pedagogy; and facilitator.

Studies investigating athletes' preferences for non-nutrition education have provided insight into these four areas. Kroshus and Baugh (2016) collected data from 325 NCAA athletes and 789 athletic trainers across several sporting disciplines to assess current content and delivery of concussion education and how that compared to athletes' preferences. In the case of delivery method, the majority of education programmes were delivered through a formal lecture or written materials (Kroshus & Baugh, 2016). Although multi-response surveys showed 57% of athletes would like to receive formal lectures, 54% also stated that video delivery would be beneficial, with only 28.7% showing a preference for written handouts (Kroshus & Baugh, 2016). Other preferences stated were posters (21.3%), e-mail (19.8%), online materials (13.0%), and webinars (7.1%) (Kroshus & Baugh, 2016). Similar work was conducted in injured or previously injured athletes from various sporting backgrounds in the U.S.A, identifying what they wanted from their healthcare professional. Across the 23 athletes, content requests were around the specifics of their injury and guidelines for returning to play (Russell & Tracey, 2011). This idea is reflected in the work of Kroshus and Baugh (2016), in which most athletes preferred that their concussion education covers all the content areas available to them. These included concussion symptoms, management, the impact on athletic and academic performance, and long-term consequences (Kroshus & Baugh, 2016). These findings may indicate a desire for a deeper, broader, and more practical understanding of the educational topics being delivered. Conducive teaching strategies developed through the work of Russel and Tracy (2011), focussed on athlete's preferences for the teaching environment. Reponses stated that an optimised atmosphere is one that allows questions to be asked, allows for sufficient time, includes positive comments, and the

opportunity for social support, creating an “open environment” where comfortable engagement in dialogue was possible (Russell & Tracey, 2011). A general consensus among athletes has not been reached in respect to the preferred facilitator, yet the most commonly preferred facilitators by athletes were the athletic trainer, physician, and coach for athletes receiving concussion education (Kroshus & Baugh, 2016).

Qualitative research focussing on the positives and negatives of an educator have provided a general foundation for the preferences of athletes towards facilitator’s intrinsic characteristics. In response to the question; ‘what makes a great coach?’, results from 18 elite, collegiate athletes in the U.S.A reveal a preference for someone who is emotional, passionate, inspirational, and enthusiastic (Becker, 2009). Analysis into the role of the sports psychologist as perceived by 75 athletes representing Canada and in preparation for the 1984 Olympic games showed preferences for someone who is likeable, knowledgeable, builds rapport, and provides a consistent service (Orlick & Partington, 1987). Both study findings agreed on the negatively perceived facilitator characteristics, with the major factors being a lack of interpersonal skills, poor management skills, and a lack of sensitivity or emotional understanding (Becker, 2009; Orlick & Partington, 1987). In addition, Orlick and Partington (1987) show through athlete feedback that psychologist contact time tended to occur during the athletes’ rest time, meaning the sacrificing of focus, information retention, and the rest time itself. This feedback provides insight into the area of education format, highlighting the importance of correct balance and dose in relation to duration and frequency.

Staying within the realm of sport psychology educational delivery, other studies have provided more on athletes’ preference for format and facilitator characteristics. Psychology consultant characteristics as rated by 217 elite, Malaysian athletes showed that regular attendance, leads a physically active lifestyle, and emphasises the teaching of mental skills were the top three most important aspects (Ponnusamy & Grove, 2014). The reporting of regular attendance aligns with the work of Orlick and Partington (1987), which showed that limited contact time with the psychologist, especially one to one, was a frequently perceived negative. Interestingly, the second top rating of leading an active lifestyle is echoed in other research, in which across 65 U.S.A high school athletes of varying disciplines, female participants believed their sport psychologist would be athletic in appearance (Blom et al., 2003). This could perhaps allude to the physical characteristics of the facilitator having an impact on their perceived credibility and the athletes’ willingness to listen.

Delivery preferences for sports psychology reported by Ponnusamy and Grove (2014) show an overall desire for continual, small doses of group/team sessions over the option of less frequent, high dose education delivery. Blom et al. (2003) also found a preference for individual and/or team services over audiotapes, self-help books, telephone services, and internet services in athletes receiving sports psychologist services. The underlying reasons for this proclivity are in agreement with the work of Russell and Tracy (2011), as the main response was that individual or team services provide an atmosphere in which educator or team interaction is possible and can enhance additional support (Blom et al., 2003). The least preferred education delivery methods among athletes were self-help books, audiotapes, and the internet, with the general theme among males and females being that they were too impersonal and lacked social interaction (Blom et al., 2003).

A recent study in non-athlete participants has yielded results not dissimilar to the preferences expressed by some athletic populations. Ashton et al. (2017) conducted focus groups and an online survey among 61 and 282 Australian males between the age of 18 and 25, respectively, to identify the overall preferences for the implementation of a nutrition and exercise education programme. In agreement with athlete-based enquiries, desired facilitator attributes were positive reinforcement, frequent feedback, and continual encouragement. Such aspects aid in the improvement of nutrition literacy, self-efficacy, and understanding of behavioural consequences (Ashton et al., 2017). There was a discrepancy between the focus groups and online survey in regards to format, with focus groups showing a desired programme duration of six months with two to three sessions per week, in contrast to the survey group wanting a shorter, three month duration with four sessions per week (Ashton et al., 2017). There was, however, agreement that there should be a flexible timetable and predominantly a face to face delivery modality (Ashton et al., 2017). This latter preference has been expressed across multiple non-athlete groups participating in exercise programmes, including postmenopausal women, sufferers of type two diabetes mellitus, and football fans (Daley et al. 2011; Forbes et al., 2010; Gray et al., 2013). Additional online support modalities were also desired, suggesting a mixed modality approach to help combat the common time-constraint barriers of the participants (Ashton et al., 2017). Nutrition content preferences were predominately around general education like eating guidelines and the enhancement of food related skills, such as eating on a budget or healthy shopping lists (Ashton et al., 2017). These broader preferences for nutrition education content were also expressed in 323 Korean parents of adolescent athletes, in which managing the nutritional

requirements of their children, they wanted to know about nutrition management for health and eating for athletic performance (Hwang et al., 2019). Aligning with the format preferences stated by Ashton el at., (2019), participants requested face to face lectures and cooking activities (Hwang et al., 2019).

To the knowledge of the researcher, only one study has specifically investigated athlete preferences for sports nutrition (Trakman et al., 2019). Survey results from 206 elite and non-elite Australian athletes show the most preferred nutrition education support is having access to sports nutrition information, followed by individual consultation, access to healthy eating information, cooking classes, and lastly; group presentations (Trakman et al., 2019).

2.9 Conclusion

Maintaining adequate nutrition has proven to be vital for athletes and achieving optimal sports performance cannot be attained in its absence. Unfortunately, research into the dietary practices of athletes show a discrepancy between eating habits and the eating recommendations set by various expert bodies. The most prominent divides being an imbalance of macronutrient intake, displacing carbohydrate's contribution with that of fat and protein, and dietary practices which result in inadequate energy intake. Although a positive correlation has been shown between nutrition knowledge and dietary practices, it is a weak or modest relationship at best. Similarly, recent work highlights positive, consistent, and significant effect sizes on athlete's dietary practices through some nutrition education programmes yet shows overall high variability between programmes. This shortcoming is suggestive of limitations in the current nutrition education environment, highlighting certain knowledge gaps among athletes and a potential disconnect between nutrition knowledge and its practical application. Despite the vast heterogeneity between nutrition education programmes, their overall effect has been a positive one for increasing nutrition knowledge, showing significant improvement among athletes. Studies in this area suggest the increased benefits of having nutrition education delivered across multiple modalities and incorporating novel, skills-based modalities such as cooking classes and supermarket shopping trips. Given the proliferation of available technologies, current sources of nutrition education for athletes are predominantly online. Online applications are already being utilised by sport nutrition educators, allowing a means to easily deliver education and resources, while also providing a convenient line of communication. More traditional sources of nutritional education are still used by athletes, including teammates, family, coach, and athletic trainer. When conceiving

of an effective nutrition education programme, it is important to consider certain factors in the athlete's life such as prioritising performance goals over nutrition goals, maintaining adequate nutrition all year round, particularly in the offseason, balancing sporting and general commitments, as well as navigating the nutrition advice given by friends and family. Finally, work investigating participant or athlete guided education frameworks has identified preferences across several variables. Preferred delivery method and pedagogy appear to be shifting from the formal lecture to a more open environment, allowing greater interaction with the educator in a one on one or team setting. Requested content has been of skills-based learning, increasing food related skills like budgeting. Suitable facilitator characteristics include and individual who is personable and who the athlete can build rapport with. A recent survey in Australian athletes found preferences for nutrition education from the internet, a dietitian, or a nutritionist (Trakman et al., 2019). However, as far as the primary researcher is aware no other studies have specifically investigated athlete preferences for nutrition education.

3 Chapter 3: Research study manuscript

What are athletes' preferences regarding nutrition education programmes?

3.1 Abstract

Background

In elite sport, high performance is entwined with optimising nutrition. Nutrition education can improve nutrition knowledge and associated skills, enhancing the likelihood of healthy dietary behaviours in athletes. The impact of which contributes to achieving optimal performance outcomes. Currently, research in this area has largely focused on an educator-designed educational framework to achieve this goal. However, limited research exists which assesses the preferences of athletes towards their nutrition education. This study aimed to explore those preferences among elite athletes in New Zealand to create an athlete-led nutrition education framework.

Methods

Elite athletes' preferences were explored through focus groups using a conceptual, deductive framework, with subsequent inductive analysis to investigate emerging themes. Participants were 20 elite, New Zealand athletes, including male and female, across various sports, and between the ages of 17 and 30 years of age. Focus groups were recorded and transcribed for thematic analysis of themes.

Results

Through the conceptual framework, four key areas were established for preferences: content; format; facilitator; and pedagogy. The major theme identified under content was for a curriculum that educated athletes on how to integrate nutrition with their performance requirements, while including activities which enhance the skills required for implementation. Format preferences were for a six-month programme, beginning in the off-season, with face to face interactions with the facilitator. Online preferences were centred around the enhancement of communication between athletes and facilitator. The ideal characteristics of the facilitator were described as someone who is non-judgmental,

approachable and knowledgeable, with a preference for someone who holds a nutrition degree at minimum. Pedagogy included an interactive classroom environment and the facilitator engaging in regular two-way feedback with the athletes.

Conclusion

Elite New Zealand athletes have a good understanding of their preferences towards their nutrition education and how best to implement it. Unfortunately, previous nutrition interventions are at odds with these preferences, potentially hindering overall efficacy. Further research in this area should aim to gather responses from a larger group of the athletic population, applying quantitative enquiry to better develop a consensus of preferences.

3.2 Introduction

To ensure optimal performance, an athlete's sport nutrition must be at its peak. The contribution of which lends itself to desirable adaptations to physical demand, providing consistent athletic performance (Jeukendrup & Gleeson, 2018). Due to the fluctuation in the athlete's sporting season, sports nutrition strategies need to be adapted to support the physical demands required. Sport nutrition, therefore, is a dynamic set of requirements, constrained primarily by the parameters set by the cycles in the training calendar (Thomas et al., 2016). The reality of achieving adequate sport nutrition is one of continual, positive food-related behaviours and dietary practice. As physiological adaptations occur during athletes recovery, continual adequacy in sports nutrition will contribute to muscle growth and wellbeing during rest (Debnath et al., 2019).

Failure to attain adequate nutrition for sport performance holds many consequences. Several studies report that when in the commonly seen state of negative energy balance, training intensity and duration become impaired with short term consequences manifesting as a decrease in lean body mass, a higher likelihood of injury, and reduced training adaptations (Blennerhasset et al., 2019; Burke et al., 2011; Logue et al., 2018; Thomas et al., 2016).

Concerningly, current nutrition knowledge of athletes has shown that across five studies which compared athletes to non-athlete group populations, the mean nutrition knowledge scores of athletes were over just 50%, which was equal to or higher than the non-athletic control groups (Heaney et al., 2011). Other results have shown not only an inadequacy in meeting sport nutrition requirements across several sports, but also not achieving the minimum nutrition recommendations for the non-athletic populations (Heaney et al., 2010;

Jenner et al., 2019; Judge et al., 2016). These studies may indicate the disconnect between nutrition knowledge and dietary practice, where although athletes may understand the importance of nutrition in sport, there may be certain barriers preventing implementation (Madrigal et al., 2016).

Such barriers include time constraints due to pressure from the coaching staff or the juggling of commitments in the athlete's personal life (Ashton et al., 2017; Bentley et al., 2019; Tam et al., 2019). Other barriers to sport nutrition adherence are competing advice from various sources, the dietary practice of friends and family, and a shortcoming in the period of time that current nutrition education programmes cover (Bentley et al., 2019; Stokes et al., 2018; Valliant et al., 2012).

Through a sport nutrition education programme, athletes will theoretically increase their nutrition knowledge, which they use to enhance their dietary behaviours and practice (Spronk et al., 2015). This has been shown outside of the athletic sphere in standard nutrition education programmes for the general public, demonstrating interventional success when the programme was of a longer duration, had fewer objectives, and was based on a learning theory (Murimi et al., 2017). Although only slightly positive, evidence exists to suggest that sport nutrition education improves knowledge and behaviour (Heikkilä et al., 2019), yet an acceptable rate of sport nutrition adherence is still not met. Although athletes do possess a relatively good understanding of sport nutrition knowledge, the application of this knowledge into dietary behaviours tends to be problematic (Hull et al., 2016). Recent systematic reviews have shown that nutrition education programmes can improve nutrition knowledge (Tam et al., 2019) and dietary intake (Boidin et al., 2020), however results are not always consistent, complicated largely by differences in study design.

Tailoring education interventions on the preferences of the people being assessed can create greater engagement, adherence, and overall efficacy (Ashton et al., 2017). However, there is scarce literature on athletic preference regarding nutrition education. Particular areas of interest within the educational framework have been proposed by Morgan et al. (2016), which states that intervention efficacy is maximised when the preferences of the defined population are incorporated across four key areas: content; format; pedagogy; and facilitator.

This current research forms the qualitative aspect of a mixed method approach to investigate elite athlete's preferences regarding their nutrition education programme.

3.3 Methods

This research used the conceptual model of Morgan et al. (2016) to guide four focus groups in conceptualising an athlete-guided, preferential framework for sports nutrition education. This model provides an approach that extends beyond targeting individual factors and is informed through current literature and the insights gained by the authors through previously delivered health promotion interventions (Morgan et al., 2016). Ethical approval for the research was granted through the Massey University Human Ethics Committee, Southern B. Written informed consent was obtained from all participants before commencing the study.

3.3.1 Participants

Twenty elite male and female athletes aged 16 years and over were recruited. Recruitment was undertaken using convenience sampling from researchers' sporting connections across the Auckland region. Elite athletes were defined as those currently competing at a national, international, or professional level. To ensure a broad coverage of responses, participants included were males and females recruited from several sporting avenues, including Massey University Academy of Sport; North Shore Rowing Club; Swimming New Zealand; Tennis New Zealand; and Motorsport New Zealand. This provided a variety of athletes including differences in age, years of experience at an elite level, team and individual athletes, as well as varying commitments to sport and general life. Data on eligible athlete demographics were obtained through a paper questionnaire prior to focus group commencement (see appendix 6.1). Recorded variables were education attainment, current sporting practice, date of birth, occupation, gender, and ethnicity (see appendix 6.2).

3.3.2 Focus group recruitment and implementation

All participant recruitment and correspondence were undertaken via email contact. Focus groups took place at Massey University, Auckland. Each consenting participant received a $40 shopping voucher for their time and travel costs. A pilot group was tested on Massey University students from the College of Health before implementation. Four focus groups were held in total, with three conducted by the main researcher as the moderator (MM) and the second researcher as the moderator assistant (HJ), and one conducted with switched roles, between September and October 2020. The moderator and moderator assistant were male and female, respectively, and were both students enrolled in Massey University's Nutrition and

Dietetics programme. Beyond the pilot testing, the two researchers had no previous experience or formal focus group training.

Focus groups included four to six people and session duration lasted 60 to 80 minutes. Each session began with an overview of the goals of the research. Both moderators gave an introduction, including academic path and nutritional interests, and the participants were encouraged to introduce themselves. No prior relationship was established between moderators and participants. Questioning was based on a semi-structured interview guide and started with an open-ended question e.g. If you had to design a nutrition education programme, what would the ideal features be? Subsequent questions probed for further insight on preferential intervention design through the four key areas: content; format; facilitator; and pedagogy (see appendix 6.3). A verbal summary was provided at the completion of each focus group and participants were invited to provide feedback on the accuracy of initial interpretations. Once the focus group was completed, the moderators compared notes, ensuring consistency of their perceptions of the responses received. The main researcher kept a journal, reflecting on the previous focus group, analysing group dynamics and critiquing moderator performance (see appendix 6.4).

3.3.3 Focus group data

The data were digitally recorded using Samsung Voice Recorder (Samsung Electronics co., Suwon-si, Korea). The recordings were then transcribed and checked for accuracy by the primary researcher (MM) before being coded using NVivo 12 software (QSR, Melbourne, Australia). Data analysis was conducted with a mixed and sequential approach, beginning with deductive, then inductive analysis, drawing overarching codes from the existing literature and complementing these with the aims and objectives of the study and interview questions (Bradley et al., 2007). The deductive step utilised the conceptual model laid out by Morgan et al. (2016) (see appendix 6.5). The inductive approach followed the method by Thomas (2006), which allows interpretation of themes through systematic processing of data. This preliminary text scanning allowed for the development of a codebook, forming the overall structure for the grouping of identified key words and themes (Fereday & Muir-Cochrane, 2006) (see appendix 6.6). Data was then coded under the main themes along with their response frequency. The data coding process utilised investigator triangulation, where coding was done by a single researcher (MM), reviewed by a second (CB), and overseen by a third (KB) to improve qualitative rigour. This also ensures agreement and that the developing

themes remained grounded in the data (Fereday & Muir-Cochrane, 2006). The main researcher kept an audit trail throughout, providing alterations in coding to maintain transparency of the process (see appendix 6.7).

3.4 Results

3.4.1 Participants

Twenty elite, male and female (75% female) athletes (22.0 ± 4.0 years) from Auckland, New Zealand participated in four mixed-gender focus groups containing four to six participants in each group. Athletes were students (*n* = 11, 55%), employed (*n* = 6, 30%), or paid athletes (*n* = 3, 15%). Participants were largely of New Zealand European descent (*n* = 11, 55%), followed by Chinese (*n* = 3, 15%), Japanese and Sri Lankan (all *n* = 2, 10%), and South East Asian and Maori (all *n* = 1, 5%). The highest educational attainment was tertiary (*n* = 11, 55%) and secondary (*n* = 9, 45%). The sport most represented was badminton (*n* = 6, 30%); followed by tennis (*n* = 4, 20%); rowing, athletics, water polo (all *n* = 2, 10%); then football, volleyball, swimming, and motorsports (all *n* = 1, 5%). The results are described in terms of athlete's preferences for content, format, facilitator, and pedagogy of nutrition education sessions. Further focus group quotations can be found in the appendices (see appendix 6.8).

3.4.2 Content preferences

Three overarching themes were identified regarding athlete preferences for content. These were the curriculum; characteristics of the curriculum; and practical/skill-based content.

3.4.2.1 Curriculum

The curriculum focuses on specific topics to be taught. All groups discussed wanting information on optimising the diet to ensure their requirements were always met. This included information regarding amounts of foods required from each food group, fuelling for specific events, nutrition across the athletic year and on a day to day basis including how to optimise recovery and specific nutritional considerations for women. Participants wanted information on dietary trends and supplements, including impartial information on these topics to better determine their efficacy, suggesting a myth-busting style of education. One suggestion for information on dietary trends was:

Participant (P)11: "…you can just have a bit of an idea of it, let's say …the vegan diet, like

what is it? What do you need to look after? And what could be the misconception or what could be the downfalls…"

3.4.2.2 Content characteristics

Participants suggested that topics should be individualised to the athlete, trustworthy, progressive, and from credible sources. The rationale is partly provided here:

P10: "Yeah in that sense, like the myth busting stuff is important because people need to understand you know what they're hearing from social media is maybe good or bad or whatever it might be."

P9: "Like the person posing with their keto tea or whatever. I guess from a young age, they might not know that maybe that's not what they actually have and things like that. "

Focus groups highlighted a shortcoming of past nutrition programmes being too static and repetitive.

P9: "…I think it sort of makes people resent it a little [nutrition education programme]… some people switch off when you have to do it again which is bad but like there's only so many times you can hear it."

3.4.2.3 Practical application/skills-based content

A disconnect for participants was taking declarative knowledge and applying it to their diet, as noted by one participant:

P7: "The thing I find really hard is kind of getting what I learned and putting it into practice and actually making those meals and keeping on top of it… personally, it's just the act of actually putting it in play."

Solutions to this issue were expressed through skills-based content. Examples included recipes, healthy meal ideas, cooking classes, food purchasing, label reading, and grocery shopping.

3.4.3 Format preferences

Athletes preferences for format covered three key areas: preferred delivery method; an online element; and the temporal, demographical, and class attendance variables of the education sessions.

3.4.3.1 Preferred delivery

Consistent among participants was the necessity of having face-to-face interaction with the facilitator, as reasoned here:

P19: "I prefer in person. I feel like I'm not very engaged when it's online like even right now with my like lectures and stuff, they're over there, I'm not even listening, and you kind of just pause and you do your own thing. But if it's in person, you're obviously not going to like not listen to the person…"

Face-to-face interaction was frequently linked to preferred education delivery being an interactive group setting, one-on-one, or more often, a mixture of the two.

Although these were the preferences, participants still expressed the need for seminar type lectures, as discussed in this focus group:

Researcher: "But to still incorporate them [seminars]?"
P9: "Yes, I think you have to, to get the information across there has to be something like that."

Unwanted delivery methods included lectures as a sole form of nutrition education delivery, large amounts of reading, and writing tasks.

3.4.3.2 Online element - phone application / website / social media

The most referenced online feature was communication via a range of modalities. Participants mentioned the ability to contact teammates, coaches, and the nutrition educator. These preferences mirrored some previous experiences of the athletes, as discussed here:

P14: "…we use messenger for all of our correspondence to do with training. So, we have like land sessions that we do every week like on the erg machine and stuff. And we'll just take photos of that and send it through to each other and that's how we kind of share that information... So, I feel like, if you were to do something where you had a group, keeping

each other, or just like updating how they're going or like a food diary on messenger or something would be a good one.

Additional communication features were team forums and live question and answer sessions with the nutrition educator. There was also a strong emphasis (3 focus groups, 15 references) on having a feature which allowed the progress and monitoring of dietary intake. This was often suggested in the form of a food diary or food logging tool. Usability and appearance were important, with participants wanting something that was easy to navigate, with a professional look. Several participants (3 focus groups, 14 references) focused on the importance of visual content, preferring to have instructional and informational videos and photos. Suggestions were made for the online platform to include recipes, and alternative food suggestions. Other, less prominent preferences were information links to different websites, cross-platform sharing, and a scanning function, allowing information on the nutritional composition of foods. Despite this, an online element was not a preference held by all participants, with some expressing this modality as undesirable. Unwanted features included the need to pay to download, joining a subscription, and the inclusion of an educational game.

3.4.3.3 Temporal, demographic, and class attendance variables of the education session

The temporal, demographical, and class attendance variables of education delivery refer to the timing and frequency of the programme, who should attend, and how many people, respectively. There was a clear preference for the nutrition education programme starting during the off-season and into the season, as explained here:

P4: "Off season I definitely think because that's when you have a little more time to actually put these things into practice and because when you get into season… you are trying to focus on your performance but if you have, you know, get the knowledge and everything in preseason then you have time to implement it into your life and hopefully by the time you get to season you're in a good routine."

Preferences for class length ranged from 30 minutes to one hour. Follow up was between 15 and 45 minutes. Preferences were more unanimous regarding education session frequency (4 focus groups, 8 references), with a preference for delivery once every month. Participants

agreed that a longer-running programme would be more beneficial, with six months being the optimal time. As reasoned by one participant:

P13: "… something where you have enough time to learn things bit by bit and put them into practice and six months seems like a good amount of time to actually have something transformative as opposed to like a one week session that overloads you…"

Regarding class attendance variables, it was more common for solo athletes to opt for other athletes who played the same sport, smaller groups of closer friends, and/or gender segregation between classes. Conversely, team-sport athletes were comfortable with larger groups, particularly when those groups consisted of their teammates. Several athletes also mentioned the importance of having a parent present for younger athletes, stating that as adolescents have less independence, their parents should be involved and educated to assist with the wider aspects of nutrition such as shopping and meal preparation. The ideal number of education session attendants ranged from six to ten people. Two people were described as too few, and over ten as too many. Beginning in a larger group then joining a smaller group for monitoring and accountability was also a suggestion.

3.4.4 Facilitator preferences

Preferences for the description of the facilitators covered personality, qualification and experience, and number and type.

3.4.4.1 Personality characteristics

Preferences were non-judgemental, knowledgeable, and approachable. Other traits included being confident, a good public speaker, and someone who stays up to date with research. Often mentioned (4 focus groups, 9 references) was the facilitator having a willingness to learn more about what is required of the athletes in the specific sport, as said here:

P10:" I think it's better if they show an interest in the sport like, for example, a personal trainer- I'm writing up a gym programme for badminton. If they actually come in and saw the movements that we're performing or let's say the nutritionist that came in and saw like - okay they have 5 to 7 seconds rest between each rally or each average rally is X amount long and understanding those sort of things that would be quite helpful."

Negative character traits were defined as poor listening skills, close-mindedness, passive aggressive comments, unempathetic, and someone who forces an opinion.

3.4.4.2 Qualifications and experience

The preferred minimum educational standard was for the facilitator to have an undergraduate degree, while others preferred someone with a postgraduate degree. Two years previous experience as a nutrition education facilitator was preferred. A reason for this was explained by one participant:

P11: "Because like the cases that they work through might be similar to yours, so then they can just pull it out and be like, this actually happened with someone that I've worked with before. Maybe this could help and then they can just take a little bit of another, like, experience that they've come across."

3.4.4.3 Number and type of facilitator

The common theme through all the focus groups was having one main facilitator with specialist or guest speakers (3 focus groups, 6 references). For example:

P13: "… Some core person the whole way through, that makes a lot of sense, but if you are going have a specific talk on a particular aspect that might become important half way through, you might have to start bringing in specific people to do that kind of stuff."

For including other staff members, preferences were for the coach. Positives comments were increased accountability, keeping informed, and for the coach to be educated in nutrition. However, participants were concerned with the coach having control over the athletes, with athletes suggesting the coach should "be in the loop as opposed to active" in their nutrition education participation. A previously experienced limitation was described:

P7: "…where it's a whole week you're away and then spend maybe half an hour or an hour talking about nutrition and it's not someone… it's literally just a higher up coach who talks about it and it's not scientific stuff or it's just, you should be eating like… very generic. Not professional at all. "

Including role models had mixed responses. Negatives were lack of interest and concern that just because it had worked for this professional athlete does not mean it works for everyone. The most common suggestion (4 focus groups, 9 references) was that the role model attended as a guest speaker, covering their athletic experience with a nutrition focus. Extra suggestions were themed around the ideas of normalising imperfection:

P8: "…not just hearing that they eat perfectly… that they found this really hard or they maybe still don't do well at this. Just sort of normalising the not being perfect part. "

3.4.5 Pedagogy preferences

Preferences in this area included the themes: goal setting and monitoring; feedback and support; and engagement and enjoyment.

3.4.5.1 Goal setting and monitoring

Participants wanted measurable and progressive goals. Several mentioned objective measures (3 focus groups, 6 references) such as targets related to macronutrient intake, body weight, and body mass index (BMI). An example:

P9: "Measurable and progressive. Sort, not just going- I want to change this completely like little steps and obviously like achievable goals that aren't just completely out of touch or not sustainable."

Researcher: "What would be an example of a measurable goal?

P9: "Like get 'yay' amount of protein per day on majority of days or cut out the majority of this sort of thing."

All agreed that nutrition goals should be set with the facilitator and suggested the coach be informed. Participants agreed that utilising teammates to increase accountability and monitoring was a good, yet optional strategy. Preferred progress monitoring was in part, scheduled, with follow ups forming part of every education session. Preferences for unscheduled monitoring was the facilitator having the ability to access the athletes' food diaries and reach out should there be any concerns.

3.4.5.2 Feedback and support

A consistent idea was follow up for the enhancement of feedback and support. The ideas

suggested were that feedback could be given on food diary inputs, overall mood, and energy levels. Ideally, feedback was reciprocal between facilitator and athlete, as rationalised here:

P12: "I think, yeah it should probably be a two-way street between nutritionist and the athlete because like if the athlete communicates to the nutritionist how they can best be helped, then it makes the nutritionist's job a little bit easier. "

For support, the most requested preference was an open line of communication between the athlete and the facilitator (3 focus groups, 11 references). Modalities included email and having the ability to schedule a face to face meeting. Another idea was the inclusion of a group activity, where the athletes could discuss their food diaries with one another. Other support strategies included a buddy system, a forum for frequently asked questions, and an email summary from the facilitator that would contain the points made from the previous education session.

3.4.5.3 Engagement and enjoyment

The most prominent theme was the interactive classroom (4 focus groups, 12 references). Described as changing the teaching atmosphere of traditional lectures, allowing open discussion, providing insight into how other people function, sharing successes and failures, and question and answer sessions. One participant describes the interaction:

P12: "Yeah, so I think a discussion- open questions, yeah great like- why did that work for you or how did you find this? That sort of question, that's fine, like curiosity."

Other, less mentioned preferences included having content relative to the sport, results as motivators, incorporating games into class, improving visual learning through posters, pictures, and graphs, and multiple learning modalities to assist athletes who learn differently.

3.5 Discussion

The purpose of this qualitative research was to elucidate the preferences of elite athletes towards their sport nutrition education. This research also serves to inform the creation of an online survey to gather a more representative perspective of elite athletes across New Zealand and Australia. Important aspects discussed around content included curriculum, content characteristics, and practical/skills-based sessions. For format, the preferences focused on the delivery method, an online teaching aspect, and the temporal, demographic, and class attendance variables of the programme. Key elements of facilitator preferences included personality, qualifications and experience, as well as number of facilitators and role. The main points for pedagogy were goal setting and monitoring, feedback and support, and engagement and enjoyment.

3.5.1 Content preferences

The desire for a curriculum that addressed the constant meeting of athletic dietary needs was characterised by preferences for specific guidance for female athletes, understanding minimum nutrition requirements, fuelling for specific events, nutrition for certain days and times of the year, and foods for recovery. These elements are associated with the concept of nutrition periodisation. The concept aligns nutrition with the longstanding concept of training periodisation, integrating the two to better adapt to physical stimuli (Freschi, 2020). Calls for nutrition on certain days, times of the athletic year, and recovery foods, relate to nutrition periodisation's macro, meso, and micro cycles present in the athlete timetable, with each one carrying specific nutrition requirements in relation to physical demands (Stellingwerff et al., 2019). Similar studies in this area have found relatable preferences, with desires for nutritional management of health and optimising performance for athlete populations (Hwang et al., 2019; Trakman et al., 2019), and eating guidelines for non-athlete populations (Ashton et al., 2017). Programmes should consider the implementation of nutrition periodisation to accommodate those athlete preferences.

Athletes wanted information on nutritional supplements and dietary trends. The use of nutritional supplements amongst athletes has shown a high prevalence in several countries, with athletes commonly lacking the scientific reasoning as to why they are taking them, holding instead the simple belief that they improve performance (Baltazar-Martins et al., 2019; Wiens et al., 2014). Similarly, dietary trends such as veganism are becoming

increasingly popular among athletes, yet can be poorly understood and therefore poorly implemented, predisposing the athlete to an array of nutrient deficiencies (Rogerson, 2017). In line with the preferences of this current study, experts suggest that nutrition practitioners should discuss appropriate supplement options with their athletes, and using the evidence, help the individual make an informed decision (McCarthy, 2019). The effects of nutrition practitioner input have shown that educating athletes on the topic is positively related to better-informed decisions about supplements (Wardenaar et al., 2017).

In terms of content characteristics, the preference for individualised nutrition feedback was shared with non-athlete, Australian men (Ashton et al., 2017). Preferences for progressive nutrition education delivery appeared to be based off participating athletes' previous experiences, which spoke of infrequent, introductory courses to nutrition. The negative aspect of which was a stagnancy of new education and a growing resentment for recycled information. The idea of credibility arose, due in part to the plethora of nutrition information available to athletes. Although previous research shows some athletes have a preference for nutrition information from a dietitian, some athletes still access information online (Trakman et al., 2019) or from their coach (Abbey et al., 2017), with some athletes feeling more comfortable with their coach rather than consulting a dietitian (Abbey et al., 2017; Judge et al., 2016). Work in the area of credibility and behaviour suggest that people have stronger advice adoption when the source shows evidence of higher credibility (Jung et al., 2016), reflected in the preferences from the focus groups in ideas like reference links on shared information.

The most prominent content preference was for practical nutrition application or skill-based teaching. This preference has been echoed in other athlete based studies, with athletes showing interest in cooking classes and cooking activities (Hwang et al., 2019; Trakman et al., 2019). Similarly, non-athlete populations share a skill development preference, highlighting cooking, recipes, budgeting, and understanding food labels (Ashton et al., 2017; Gray et al., 2013). Food skills, particularly preparation, shopping, and budgeting, are strong predictors of higher diet quality (Lavelle et al., 2019). Evaluation of interventions of this nature have shown better participant enjoyment, improved self-efficacy, while being educationally appropriate and convenient (Tam et al., 2019). Future programmes should look to step away from traditional, theory-based curricula to prevent the neglect of such popular areas of nutrition education.

3.5.2 Format preferences

The face to face delivery method has been a shared preference across non-athlete populations, from young men, women, football fans, and those with type two diabetes mellitus (Ashton et al., 2017; Daley et al., 2011; Forbes et al., 2010; Gray et al., 2013). In the current study, participating athletes recognised the utility of formal lectures/seminars and interactive group settings to relay greater amounts of knowledge yet called for an additional one on one follow-up style modality. Future education delivery should aim to overcome the limitations of the formal lecture/seminar by offering a multiple modality approach and adopting a technological focus. Similar results have been observed in Australian athletes who selected the dietitian and internet as their first and second preferred sources of nutrition education, respectively (Trakman et al., 2019).

A desired online feature was to provide athlete progress and monitoring. Preferences gained from recreational exercisers are in agreement, with the top requirement of exercise performance based applications being assistance with exercise monitoring and providing insight into performance (Dallinga et al., 2018). Preferences for online modalities to be easy to navigate with high usability compares to work undertaken among behavioural and sports scientists investigating important features for enhancing the effectiveness of sport and health related mobile applications. Usability was the most frequently reported necessary feature for an application and appeared to influence perceptions of overall application effectiveness (Dallinga et al., 2017). In the current study, usability was tied into preferences for visual content, recipe suggestions, food scanning functions, and information linking and sharing across online platforms. Communication was another important feature of the online element in the current study. Exploration into the opinions of Australian physiotherapy students, similarly found that the most appealing and desired aspects of online material were facilitated peer collaboration, complementary learning, and enhanced communication with peers and educators (Maloney et al., 2014). Communication was also highlighted as an online feature which enables athlete support by sports nutritionists who already incorporate an online modality into their nutrition education (Dunne et al., 2019),

The temporal parameter, programme commencement, showed unanimity with athletes preferring it in the off-season versus in the competition season. Reasons stated were around creating a foundation and routine with more time in the off-season. This is underpinned by the idea that repeated practice over time is necessary to successfully adopt and implement

behaviour changes (Olander, 2007). Time constraints have been mentioned by athletes in previous research as a major barrier to achieving nutritional adequacy (Heaney et al., 2008). This may explain why preferred session time was 30-60 minutes with 15-45-minute follow-ups, and session frequency was commonly preferred to be once per month. The preference for a total education programme duration of six months is in line with previous research into non-athlete populations (Ashton et al., 2017) and differs from previously assessed nutrition education interventions that are typically less than four weeks (Tam et al., 2019). Programmes longer than five months have shown higher rates of success in non-athlete populations (Murimi et al., 2017). Preferences for class size identified an appropriate range of six to ten athletes, with two athletes being too few and over ten, too many. There was also suggestion of a larger class which broke off into smaller accountability groups. Groups greater than 15 have been identified as too many in non-athlete research, with individuals in bigger groups potentially deterred from sharing with the class (Gray et al., 2013). Similarly, it may be harder in larger groups to correct individual knowledge deficits and accommodate individual differences (Tam et al., 2019).

Class attendance variable preferences varied among the participants. One potential reason for this was the combination of team and solo athletes, where athletes in team sports were comfortable with teammate inclusion, whereas solo athletes preferred friends, people of the same sport, or the same gender. A frequent suggestion was the involvement and education of parents of younger athletes, due to the athletes' lack of autonomy and need of assistance in some wider aspects of nutrition like grocery shopping and meal preparation.

3.5.3 Facilitator preferences

Athletes stressed the importance of having a facilitator who is non-judgmental and approachable. Recent research has reported exactly that, with athletes expressing a person-first approach through these characteristics as vital for developing a strong relationship (Bentley et al., 2020). Moreover, athletes believed that through these characteristics and better cultivation of rapport, a more honest dialogue could be held about dietary behaviours, allowing for better support (Bentley et al., 2020). A high level of knowledge, a willingness to learn, being university qualified, and having at least two years of previous facilitator experience were preferred facilitator characteristics in the current study. Teacher knowledge strongly predicts student performance and is central for high quality instruction in a traditional teaching environment (Fischer et al., 2018). Teaching instruction is also largely

enhanced by years of teaching and overall experience (Fischer et al., 2018). Other preferences included a facilitator who is confident, a good speaker, and stays up-to-date with research.

Preferences for facilitator number were most commonly one central person with guest or specialist speakers for certain topics. Although coach inclusion as a facilitator in the nutrition education programme was not preferred, some athletes understood the need to include coaches in a passive role to maintain message consistency and added accountability. Previous warnings in this area have highlighted food and body weight misconceptions spread by coaches, ultimately hindering athletes' dietary adherence (Bentley et al., 2019). The over extension of control described in this study ties in with Bentley el al., (2019) in which they describe role conflict in the squad, where the coach exerts their dominance on the nutrition sphere, bringing with them their bias and unsubstantiated personal advice. Other coach-related inhibitory contributors have been lack of empathy, player understanding, and inability to motivate (Blecharz et al., 2014). In addition to nutritional education, recommendations have been made for coach education that highlights the stressors that they create and contribute to (Bentley et al., 2020). Role model inclusion remained indefinite, with some athletes wanting them solely as guest speakers to share their athletic experience, while other athletes were concerned that personal experience is not generalisable and expressed disinterest.

3.5.4 Pedagogy preferences

The preferences towards feedback, goal setting, monitoring, and support through two-way, open communication all revolved around regular follow ups. The athletes understood that the follow-up sessions acted as the conduit for these preferences to be enacted and sustained. Contemporary work has explored the use of the Nutrition Care Process (NCP), a structured guide to nutrition care for use in a clinical setting in the athletic environment (Mustafa et al., 2020). Using the NCP's integral parts: information gathering; the nutrition prescription; goal and action negotiation; nutritional recommendations; and regular follow up (Swan et al., 2019), sports nutrition facilitators can provide a more individual and comprehensive service to athletes (Mustafa et al., 2020), while also meeting desired preferences.

Ideas for engagement and enjoyment saw the re-imagining of the class environment, with the evolving of the lecture/seminar into something more interactive with multiple learning modalities. These ideas are mirrored in a previous study between injured athletes and their healthcare professionals, where the desired atmosphere was described as an open

environment, offering the asking of questions, social support, and comfortable engagement in dialogue (Russell & Tracy, 2011). Given that millennials (born 1981-96) have grown up with expanding technological advancements, they have a growing intolerance for lecture/seminar style classrooms (Roehl et al., 2013). A situation even more relevant for Generation Z (born 1997-2012). Through more active interaction, athletes can develop a deeper learning beyond the superficial retention of knowledge and facts (Roehl et al., 2013). A strategy to this is that of the active classroom, where time in class consists of developing knowledge and competency through activities, enhanced active learning, peer assistance, and collaboration (Akçayır & Akçayır, 2018; LeClair et al., 2018). Athletes and facilitators also build stronger rapport through more time spent up front and interacting with one another (Blanton et al., 2019). Future nutrition programmes could look to incorporate this approach to improve athlete engagement and enjoyment, as well as bridging the gap between nutrition knowledge and its application in dietary practice.

3.5.5 Strengths and limitations

This research provides novel insight through qualitative analysis into elite athletes' preferences for their nutrition education programmes and the developing of an athlete-led education framework. These findings also create the foundation for further quantitative analysis in this area of research, among both New Zealand and Australian athletes. This future research will help strengthen the findings of the current research and provide greater insight into athlete preferences across a larger, more representative pool. Using investigator triangulation, respondent validation of initial interpretations, a moderator journal, and audit trail of coding alterations, the data collection and analysis process of this study contain qualitative rigour, strengthening the overall methodology.

Limitations mainly stemmed from the participants' demographic variables. For example, a small sample size combined with athletes only being selected from the Auckland region, meaning preferences found may not account for certain geographic considerations, such as access, and may not be extrapolatable to the wider athlete community in New Zealand and Australia. Issues with generalisability were also apparent due to the varying exposure of athletes to sport nutrition experiences. This often found those less experienced athletes unsure of their preferences for nutrition education as they were unfamiliar with the options available to them. Similarly, this lack of exposure may have meant that athletes provided ill-thought out answers as they encountered questions about nutritional and educational aspects they had

never considered or experienced. Although diversity of opinion was provided through varying sporting backgrounds, some sports were not represented or underrepresented. There was also the potential for results to largely resemble a female perspective, due to their larger numbers in the focus groups. Also, the combination of team and solo athletes potentially provided limitations during the focus groups, with solo athletes less likely to share an opposing opinion to the majority. Moreover, given that team and solo sporting environments differ, the preferences provided could reflect this, meaning where one preference may be suitable for a team dynamic, it may lack feasibility for the individual athlete.

3.5.6 Conclusion

Elite New Zealand athletes have a shared interest for a nutrition education curriculum that teaches nutrition periodisation that is integrated with training and performance requirements and information on diet trends and supplements. The nature of this education needs to be individualised, progressive, and credible. Athletes want more practical application and skills-based learning in their education, along with a face to face group, one on one, or mixed teaching environment. The education programme starts ideally in the off season, running six months in total, with classes once a month for 30 to 60 minutes and 15-45-minute follow ups in between. Although there was disagreement on an online form of delivery, preferable features were improved facilitator and teammate communication, progression monitoring, high usability, and visually appealing content. Class size was identified as six to ten people with two being too few and over ten, too many. Preferences differed between solo and team athletes regarding class attendance variables, yet many agreed that younger athletes should have the option to bring a parent. The preferred facilitator characteristics were being non-judgmental and knowledgeable, while at minimum, holding a nutrition degree and two years previous experience. Athletes agreed that there should be one main facilitator with specialist facilitators as needed. Role model inclusion was not fully accepted, with athletes in favour choosing to keep them solely as guest speakers. Similarly, the coach was preferred to be in only a static role in the programme. Preferences for pedagogy were based around the continual follow up to enhance the elements goal setting, monitoring, feedback, and support. This included setting objective and measurable goals with the facilitator to enhance monitoring and goal setting. Feedback and support were best improved through two-way, open lines of communication. Engagement and enjoyment were considered enhanced when

education sessions were more interactive and open discussion could be held. Established preferences in this study conflict with the previous nutrition intervention designs described by the athletes. Certain variables such as limited geographic inclusion, small sample size, a lack of prior nutrition education, underrepresented sports, and a predominantly female participant pool may have created the potential for an incomplete picture of athletes' nutrition education preferences. Further research should use the established parameters in this work to identify, quantitatively, the extent of each preference over a larger, more representative group of elite athletes. This would develop a more comprehensive, athlete-led framework for nutrition education delivery.

4 Chapter 4: Conclusion

4.1 Overview and achievement of the aims and objectives of the study

The aim of this study was to collaborate with elite New Zealand athletes to identify their preferences for a nutrition education programme. This was achieved through the conceptual model from Morgan et. al. (2016), which formed the basis for the four main theme areas of the study: content; format; facilitator; and pedagogy. Through conducting focus groups, these areas were explored, yielding a deeper and more nuanced understanding from the athlete perspective. Content preferences indicated nutrition periodisation to be popular as well as dietary trends, supplements, and skills-based education that was individual, progressive, and credible. Format preferences highlighted a desire for a six-month nutrition education programme, starting in the offseason, and providing 30-60-minute classroom sessions each month with 15-45-minute follow ups in between. Delivery was predominantly face to face with group classes, one to one, or beginning in a larger group then breaking into smaller groups. Although online delivery was not a preference shared by all athletes, the main preferences were for communication, progress, and monitoring features, while also being easy to navigate with visually appealing content. The number of athletes per class was preferred to be between six and ten, with two being too few and above ten; too many. Class attendance variables differed between athletes, with solo sport athletes preferring a group of friends, of the same sport, and/or of the same gender, and team sport athletes being comfortable with a larger group of teammates. The need for parent attendance was often suggested for younger athletes as they do not have an adequate level of independence and require parental assistance. The facilitator team was described as one central figure with specialist speakers as required. There was preference for the inclusion of role models as guest speakers to share their experiences, yet some athletes identified a lack of generalisability and expressed disinterest. Similarly, coach inclusion was contested, with concern of an overreach of control. Despite this, most athletes wanted their coaches involved but in a static position, staying informed of athletes' progress and potentially being educated themselves. The facilitator themself was someone who was non-judgemental, knowledgeable, approachable, confident, a good public speaker, shows a willingness to learn the sport, and stays up to date with research, holding a university degree and at least two years previous experience. Athletes' preferences for pedagogy centred on the follow-up session to improve goal setting, monitoring, feedback, and support. Strategies included two-way open lines of communication

between athlete and facilitator, setting objective goals with the facilitator, holding regular, scheduled follow ups, and the use of unscheduled monitoring. Engagement and enjoyment were considered achieved when the classroom provided an interactive environment that cultivated open discussion and used multiple learning modalities.

Through the objectives and aims outlined in Chapter 1, this study has provided the first qualitative insights into athletes' preferences for their nutrition education. By creating the foundations for this area, future studies, including the planned broader survey, can develop a richer understanding and begin to implement some of the knowledge gained here into nutritional educational programmes and then test the efficacy among the elite athlete population.

This research has provided insight, not only into the preferences of athletes but some insight into the current nutrition education environment based on information reported in the focus groups. The current technique of the lecture style classroom and repetitive information is not well received among athletes. Similarly, athletes lack the practical skills to fully implement the knowledge they are receiving in the classroom. The preferences reported by athletes in this study suggest a more interactive engagement with facilitator and athletes, while providing the opportunity to learn those skills that are necessary to attain nutritional adequacy. In addition, the athletes envisioned a longer programme, with more frequent follow ups, and a personable facilitator, with whom they could build good rapport.

As nutrition is so intimately linked with sports performance, having a better understanding of athletes' preferences allows for the development of a better-informed nutrition education programme. The idea being that through a programme based on the preferences of athletes, their barriers will be overcome and enables athletes the best chance at knowledge attainment and retention with a greater ability for nutrition strategy implementation. The effect of which sees athletes with greater sports performance, combined with healthier dietary behaviours that extend into their everyday lives.

4.2 Strengths and limitations

This study has informed a mixed method approach with a survey planned to be built on these qualitative findings. The results of the quantitative aspect will help consolidate the results found here and provide evidence that is more representative of the athlete population. This research is the first to qualitatively analyse the nutrition education preferences of athletes in the development of a sport nutrition education framework. The qualitative methodology used is also a strength of this work, utilising key techniques such as investigator triangulation, respondent validation of initial interpretations, clear exposition of methods through an audit trail, and the use of a moderator journal. More general limitations include the combination of team and solo athletes. Although positive in the sense of diversifying opinion, this was potentially negative in that athletes felt less comfortable sharing opposing opinions, especially when fewer in number. The combination also meant that preferences were delivered based off different sporting environments and dynamic, where one preference may suit a team setting, yet it would not be viable in the solo athlete experience. Generalisability was also an issue as athletes were selected only from the Auckland region and may not be representative of the wider athlete community of New Zealand. Similarly, some sports were underrepresented or not represented in this research. Given that the focus groups had a large female representation, there is the potential for results to reflect a more female perspective on nutrition education preferences. Athletes varied greatly in their previous sport nutrition experiences. This may have meant some athletes were faced with questions they had never considered before, meaning a superficial answer through a lack of time to think it through. It was also difficult for those athletes with no previous sport nutrition experience to define their preferences for it, having no understanding of the different variables available to them.

4.3 Final recommendations

Common preferences under curriculum were for fuelling for certain events, foods for recovery, and eating for different periods in the athletic year. As these all tie into the idea of nutrition periodisation, or integrating nutrition into performance periodisation, nutrition programmes should look to implement nutrition periodisation strategies which align with performance requirements. Considering the preference for supplement and dietary trend education among the athletes, and the emergence of these topics in the athletic sphere and beyond, facilitators should provide their athletes with credible information on the evidence

behind the efficacy of diets and supplements, any associated risks or considerations, and how they can be incorporated into a dietary pattern that achieves nutritional adequacy.

Practical or skills-based education was deemed to be an important feature among the athletes for the nutrition education programme, bridging the gap between receiving the knowledge and putting it into practice. Programmes should include activities within the curriculum which build on these skills, utilising the emerging strategies such as grocery shopping trips, cooking classes, and label reading**.** In any case, the content of the programme needs to be credible, individualised for the athlete, and progressive in nature, allowing the continual development of knowledge, skills, and confidence as the athlete progresses through their career.

In contrast to current practice, the athletes suggested having a longer programme, generally lasting six months and beginning in the off-season. Addressing these preferences, facilitators should plan a programme which begins before the competitive season and continues for a minimum of six months to create something transformative for athletes instead of a programme with only short-term impact and retention.

The shortcomings of current practice were also evident in the recalling of athletes, where nutrition education sessions were of a lecture dynamic, creating resentment among the athletes and a lack of desire to attend what was perceived as a chore. On these grounds, the facilitator should re-imagine the classroom environment, creating a highly interactive approach to enhance engagement and enjoyment with regular follow ups and two-way feedback. To complement this, facilitators should be non-judgemental, approachable, and knowledgeable, having attained a degree in nutrition with previous experience in the field. Care should be taken when including other staff outside of nutrition to prevent any over-reach of control in this area. To prevent this, the facilitators can include such members as the coach in the programme, yet in a static relationship, keeping them informed of current progress but discouraging their engagement to any great extent.

The use of a mobile phone application or web-based platform is suggested but only as a supplement to face to face nutrition education. Further research conceptualising the ideal features of such a platform is needed. A deeper understanding in this area could be gained by research testing prototype instruments among athletes through consumer trials, fine-tuning as feedback is provided.

Limitations include a relatively small sample size (although data saturation was reached), limited geographical inclusion, some sports being underrepresented, insufficient nutrition education experience of participants, and a sample that was largely female may have skewed results; these may have contributed to an incomplete picture of athletes' preferences for nutrition education.

Further quantitative research will be undertaken to gain further insight into the preferences of elite athletes and expand on the ideas established here. This research will also present a more complete understanding of elite athletes' preferences and provide a greater representation of the New Zealand and Australian elite athlete populations. The final result should see a comprehensive, athlete-designed nutrition education programme, which could be implemented and compared with current practices.

5 References

Abbey, E. L., Wright, C. J., & Kirkpatrick, C. M. (2017). Nutrition practices and knowledge among NCAA Division III football players. *Journal of the International Society of Sports Nutrition*, 14(1), 1-9.

Ahmed, O. H., Weiler, R., Schneiders, A. G., McCrory, P., & Sullivan, S. J. (2015). Top tips for social media use in sports and exercise medicine: doing the right thing in the digital age. *British Journal of Sports Medicine,* 49(14), 909-910.

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: a review of its advantages and challenges. *Computers & Education,* 126, 334-345.

Ashton, L. M., Morgan, P. J., Hutchesson, M. J., Rollo, M. E., & Collins, C. (2017). Young men's preferences for design and delivery of physical activity and nutrition interventions: a mixed-methods study. *American Journal of Men's Health,* 11(5), 1588-1599.

Baltazar-Martins, G., de Souza, D. B., Aguilar-Navarro, M., Muñoz-Guerra, J., del Mar Plata, M., & Del Coso, J. (2019). Prevalence and patterns of dietary supplement use in elite Spanish athletes. *Journal of the International Society of Sports Nutrition,* 16(1), 30.

Baugh, C. M., Kroshus, E., Daneshvar, D. H., & Stern, R. A. (2014). Perceived coach support and concussion symptom-reporting: differences between freshmen and non-freshmen college football players. *The Journal of Law, Medicine & Ethics,* 42(3), 314-322.

Becker, A. J. (2009). It's not what they do, it's how they do it: athlete experiences of great coaching. *International Journal of Sports Science & Coaching*, 4(1), 93-119.

Bensley, R. J., Anderson, J. V., Brusk, J. J., Mercer, N., & Rivas, J. (2011). Impact of internet vs traditional Special Supplemental Nutrition Program for Women, Infants, and Children nutrition education on fruit and vegetable intake. *Journal of the American Dietetic Association,* 111(5), 749-755.

Bentley, M. R., Mitchell, N., Sutton, L., & Backhouse, S. (2019). Sports nutritionists' perspectives on enablers and barriers to nutritional adherence in high performance sport: a qualitative analysis informed by the COM-B model and theoretical domains framework. *Journal of Sports Sciences,* 37(18), 2075-2085.

Bentley, M. R., Patterson, L. B., Mitchell, N., & Backhouse, S. H. (2020). Athlete perspectives on the enablers and barriers to nutritional adherence in high-performance sport. *Psychology of Sport and Exercise,* 52, 101831.

Blanton, J. E., Linhart, C., & Ault, K. J. (2019). Flipping the script: using an online captain's course to leverage leadership development training with youth club soccer athletes. *Journal of Sport Psychology in Action,* 10(3), 151-159.

Blecharz, J., Luszczynska, A., Scholz, U., Schwarzer, R., Siekanska, M., & Cieslak, R. (2014). Predicting performance and performance satisfaction: mindfulness and beliefs about the ability to deal with social barriers in sport. *Anxiety, Stress, & Coping,* 27(3), 270-287.

Blennerhasset, C., Sparks, A., Mcnaughton, L., Cronin, L., Nelson, L., & Stone, G. (2019). An exploration of the factors that influence ultra-endurance athletes' food choices

during competition. Paper presented at the International Sport and Exercise Nutrition Conference.

Blom, L. C., Hardy, C. J., Burke, K. L., & Joyner, A. (2003). High school athletes' perceptions of sport psychology and preferences for services. *International Sports Journal,* 7(2), 18.

Boidin, A., Tam, R., Mitchell, L., Cox, G. R., & O'Connor, H. (2020). The effectiveness of nutrition education programs on improving dietary intake in athletes: a systematic review. *British Journal of Nutrition*, 1-36.

Bourke, B. E. P., Baker, D. F., & Braakhuis, A. J. (2019). Social media as a nutrition resource for athletes: a cross-sectional survey. *International Journal of Sport Nutrition & Exercise Metabolism,* 29(4), 364-370.

Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: developing taxonomy, themes, and theory. *Health Services Research*, 42(4), 1758-1772.

Buffington, B. C., Melnyk, B. M., Morales, S., Lords, A., & Zupan, M. R. (2016). Effects of an energy balance educational intervention and the COPE cognitive behavioral therapy intervention for Division I US Air Force Academy female athletes. *Journal of the American Association of Nurse Practitioners,* 28(4), 181-187.

Burke, L. M., Hawley, J. A., Wong, S. H. S., & Jeukendrup, A. E. (2011). Carbohydrates for training and competition. *Journal of Sports Sciences,* 29(sup1), S17-S27.

Burrows, T., Harries, S. K., Williams, R. L., Lum, C., & Callister, R. (2016). The diet quality of competitive adolescent male rugby union players with energy balance estimated using different physical activity coefficients. *Nutrients*, 8(9), 548.

Daley, A., Stokes-Lampard, H., Wilson, S., Rees, M., Roalfe, A., & MacArthur, C. (2011). What women want? Exercise preferences of menopausal women. *Maturitas,* 68(2), 174-178.

Dallinga, J. M., van der Werf, J. E., Janssen, M., Vos, S., & Deutekom-Baart de la Faille, M. (2017). Which features are important for effectiveness of sport-and health-related apps?: Results of focus groups with experts. Paper presented at the Science and Engineering Conference on Sports Innovation.

Dallinga, J. M., van der Werf, J., Janssen, M., Laurijssens, S., Vos, S., & Deutekom, M. (2018). App preferences and experiences of recreational runners, cyclists and walkers. Presented at the congress of the European College of Sport Science.

Debnath, M., Chatterjee, S., Bandyopadhyay, A., Datta, G., & Dey, S. K. (2019). Prediction of athletic performance through nutrition knowledge and practice: a cross-sectional study among young team athletes. *Sport Mont,* 17(3), 13-20.

Desbrow, B., McCormack, J., Burke, L. M., Cox, G. R., Fallon, K., Hislop, M., ... Leveritt, M. (2014). Sports Dietitians Australia position statement: sports nutrition for the adolescent athlete. *International Journal of Sport Nutrition and Exercise Metabolism*, 24(5), 570-584.

Devlin, B. L., Leveritt, M. D., Kingsley, M., & Belski, R. (2017). Dietary intake, body composition, and nutrition knowledge of Australian football and soccer players:

implications for sports nutrition professionals in practice. *International Journal of Sport Nutrition and Exercise Metabolism,* 27(2), 130-138.

DuBose, J. (2012). What is the effect of a hydration education intervention on the knowledge and practices of Southeast Texas high school male athletes? [thesis] : Lamar University.

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.

Eck, K. M., & Byrd-Bredbenner, C. (2019). Food choice decisions of athletes: insights from sports dietitians. *Topics in Clinical Nutrition,* 34(3), 186-199.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods,* 5(1), 80-92.

Fischer, C., Fishman, B., Dede, C., Eisenkraft, A., Frumin, K., Foster, B., & McCoy, A. (2018). Investigating relationships between school context, teacher professional development, teaching practices, and student achievement in response to a nationwide science reform. *Teaching and Teacher Education,* 72, 107-121.

Folasire, O. F., Akomolafe, A. A., & Sanusi, R. (2015). Does nutrition knowledge and practice of athletes translate to enhanced athletic performance? Cross-sectional study amongst nigerian undergraduate athletes. *Global Journal of Health Science,* 7(5), 215.

Forbes, C. C., Plotnikoff, R. C., Courneya, K. S., & Boulé, N. G. (2010). Physical activity preferences and type 2 diabetes. *The Diabetes Educator,* 36(5), 801-815.

Freschi, M. (2020). Nutrition aspects. In *Injury and Health Risk Management in Sports* (pp. 393-398): Springer, Berlin, Heidelberg.

Gray, C. M., Hunt, K., Mutrie, N., Anderson, A. S., Leishman, J., Dalgarno, L., & Wyke, S. (2013). Football Fans in Training: the development and optimization of an intervention delivered through professional sports clubs to help men lose weight, become more active and adopt healthier eating habits. *BMC Public Health,* 13(1), 232.

Hassapidou, M., & Manstrantoni, A. (2001). Dietary intakes of elite female athletes in Greece. *Journal of Human Nutrition and Dietetics,* 14(5), 391-396.

Heaney, S., O'Connor, H., Gifford, J., & Naughton, G. (2010). Comparison of strategies for assessing nutritional adequacy in elite female athletes' dietary intake. *International Journal of Sport Nutrition and Exercise Metabolism*, 20(3), 245-256.

Heaney, S., O'Connor, H., Michael, S., Gifford, J., Naughton, G. (2011). Nutrition knowledge in athletes: a systematic review. *International Journal of Sport Nutrition and Exercise Metabolism,* 21(3), 248-261.

Heaney, S., O'Connor, H., Naughton, G., & Gifford, J. (2008). Towards an understanding of the barriers to good nutrition for elite athletes. *International Journal of Sports Science & Coaching,* 3(3), 391-401.

Heikkilä, M., Lehtovirta, M., Autio, O., Fogelholm, M., & Valve, R. (2019). The impact of nutrition education intervention with and without a mobile phone application on nutrition knowledge among young endurance athletes. *Nutrients,* 11(9), 2249.

Hull, M. V., Jagim, A. R., Oliver, J. M., Greenwood, M., Busteed, D. R., & Jones, M. T. (2016). Gender differences and access to a sports dietitian influence dietary habits of collegiate athletes. *Journal of the International Society of Sports Nutrition,* 13(1), 38.

Hwang, J. H., Kim, J. Y., Kim, K. A., & Kim, K. W. (2019). Status and needs sssessment on nutrition management and meal service for elementary, middle, and high school athletes among athlete's parents. *Korean Journal of Community Nutrition,* 24(1), 47-59.

Jenner, S. L., Buckley, G. L., Belski, R., Devlin, B. L., & Forsyth, A. K. (2019). Dietary intakes of professional and semi-professional team sport athletes do not meet sport nutrition recommendations—a systematic literature review. *Nutrients,* 11(5), 1160.

Jeukendrup, A., & Gleeson, M. (2018). *Sport nutrition*: Human Kinetics.

Jospe, M. R., Fairbairn, K. A., Green, P., & Perry, T. L. (2015). Diet app use by sports dietitians: a survey in five countries. *Journal of Internet Medical Research, mHealth, and uHealth,* 3(1), e7.

Judge, L. W., Kumley, R. F., Bellar, D. M., Pike, K. L., Pierson, E. E., Weidner, T., . . . Friesen, C. A. (2016). Hydration and fluid replacement knowledge, attitudes, barriers, and behaviors of NCAA division 1 American football players. *Journal of Strength and Conditioning Research,* 30(11), 2972-2978.

Jung, E. H., Walsh-Childers, K., & Kim, H. S. (2016). Factors influencing the perceived credibility of diet-nutrition information web sites. *Computers in Human Behavior,* 58, 37-47.

Karpinski, C., Touger-Decker, R., Denmark, R., Rigassio-Radler, D., & Rosenbloom, C. (2012). Impact of a nine-week interactive internet-based nutrition education program on nutrition knowledge and dietary behaviors of collegiate athletes. *Journal of the Academy of Nutrition and Dietetics,* 112(9), A15.

Kroshus, E., & Baugh, C. (2016). Concussion education in US collegiate sport: what is happening and what do athletes want?. *Health Education & Behavior,* 43(2), 182-190

Lavelle, F., Bucher, T., Dean, M., Brown, H. M., Rollo, M. E., Collins, C. E. (2019). Diet quality is more strongly related to food skills rather than cooking skills confidence: results from a national cross-sectional survey. *Nutrition & Dietetics*, 77(1), 112-120.

LeClair, R. J., Thompson, K. H., & Binks, A. P. (2018). A universal guide to transitioning didactic delivery into an active classroom. *Medical Science Educator*, 28(4), 757-764.

Lieffers, J. R., Vance, V. A., & Hanning, R. M. (2014). Use of mobile device applications in Canadian dietetic practice. *Canadian Journal of Dietetic Practice and Research,* 75(1), 41-47.

Logue, D., Madigan, S. M., Delahunt, E., Heinen, M., Mc Donnell, S.-J., & Corish, C. A. (2018). Low energy availability in athletes: a review of prevalence, dietary patterns, physiological health, and sports performance. *Sports Medicine,* 48(1), 73-96.

Lohse, B. (2013). Facebook is an effective strategy to recruit low-income women to online nutrition education. *Journal of Nutrition Education and Behavior,* 45(1), 69-76.

Madrigal, L., Wilson, P. B., & Burnfield, J. M. (2016). Nutritional regrets and knowledge in National Collegiate Athletic Association Division I athletes: establishing a foundation for educational interventions. *Journal of Issues in Intercollegiate Athletics,* 9.

Maloney, S., Moss, A., & Ilic, D. (2014). Social media in health professional education: a student perspective on user levels and prospective applications. *Advances in Health Sciences Education,* 19(5), 687-697.

McCarthy, C. (2019). Help student-athletes read between the lines before using dietary supplements. *College Athletics and the Law,* 15(12), 1-5.

McKean, M., Mitchell, L., O'Connor, H., Prvan, T., & Slater, G. (2019). Are exercise professionals fit to provide nutrition advice? An evaluation of general nutrition knowledge. *Journal of Science and Medicine in Sport,* 22(3), 264-268.

Morgan, P. J., Young, M. D., Smith, J. J., & Lubans, D. R. (2016). Targeted health behavior interventions promoting physical activity: a conceptual model. *Exercise and Sport Sciences Reviews,* 44(2), 71-80.

Murimi, M. W., Kanyi, M., Mupfudze, T., Amin, M. R., Mbogori, T., & Aldubayan, K. (2017). Factors influencing efficacy of nutrition education interventions: a systematic review. *Journal of Nutrition Education and Behavior,* 49(2), 142-165. e141.

Mustafa, N., Safii, N. S., Mohamad, M. I., Sameeha, M. J., Rahman, A. H. A., Ahmad, A., . . . Poh, B. K. (2020). Sports nutritionists adopt the nutrition care process (NCP) road map to develop individualized meal planning for athletes. [thesis].

Nikolaus, C. J., Muzaffar, H., & Nickols-Richardson, S. M. (2016). Grocery store (or supermarket) tours as an effective nutrition education medium: a systematic review. *Journal of Nutrition Education and Behavior,* 48(8), 544-554.

Olander, C. (2007). Nutrition education and the role of dosage: US Department of Agriculture, Food and Nutrition Service Washington, DC.

Orlick, T., & Partington, J. (1987). The sport psychology consultant: analysis of critical components as viewed by Canadian Olympic athletes. *The Sport Psychologist,* 1(1), 4-17.

Ponnusamy, V., & Grove, J. R. (2014). Sport psychology service provision: preferences for consultant characteristics and mode of delivery among elite Malaysian athletes. *Journal of Sports Science & Medicine,* 13(3), 638.

Raizel, R., da Mata Godois, A., Coqueiro, A. Y., Voltarelli, F. A., Fett, C. A., Tirapegui, J., . . . de Faria Coelho-Ravagnani, C. (2017). Pre-season dietary intake of professional soccer players. *Nutrition and Health,* 23(4), 215-222.

Rash, C. L., Malinauskas, B. M., Duffrin, M. W., Barber-Heidal, K., & Overton, R. F. (2008). Nutrition-related knowledge, attitude, and dietary intake of college track athletes. *The Sport Journal,* 11(1), 48-55.

Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The flipped classroom: an opportunity to engage millennial students through active learning strategies. *Journal of Family & Consumer Sciences,* 105(2), 44-49.

Rogerson, D. (2017). Vegan diets: practical advice for athletes and exercisers. *Journal of the International Society of Sports Nutrition,* 14(1), 36.

Russell, H., & Tracey, J. (2011). What do injured athletes want from their health care professionals?. *International Journal of Athletic Therapy and Training,* 16(5), 18-21.

Shriver, L. H., Betts, N. M., & Wollenberg, G. (2013). Dietary intakes and eating habits of college athletes: are female college athletes following the current sports nutrition standards? *Journal of American College Health*, 61(1), 10-16.

Simpson, A., Gemming, L., Baker, D., & Braakhuis, A. (2017). Do image-assisted mobile applications improve dietary habits, knowledge, and behaviours in elite athletes? A pilot study. *Sports (Basel, Switzerland)*, 5(3), 60. https://doi.org/10.3390/sports5030060

Spronk, I., Kullen, C., Burdon, C., & O'Connor, H. (2014). Relationship between nutrition knowledge and dietary intake. *British Journal of Nutrition*, 111(10), 1713-1726.

Spronk, I., Heaney, S. E., Prvan, T., & O'Connor, H. T. (2015). Relationship between general nutrition knowledge and dietary quality in elite athletes. *International Journal of Sport Nutrition & Exercise Metabolism*, 25(3), 243-251.

Stellingwerff, T., Morton, J. P., & Burke, L. M. (2019). A framework for periodized nutrition for athletics. *International Journal of Sport Nutrition and Exercise Metabolism*, 29(2), 141-151.

Stokes, E. G., Hughes, R., Shaw, D. M., O'Connor, H. T., & Beck, K. L. (2018). Perceptions and determinants of eating for health and performance in high-level male adolescent rugby union players. *Sports*, 6(2), 49.

Swan, W. I., Pertel, D. G., Hotson, B., Lloyd, L., Orrevall, Y., Trostler, N., ... & Papoutsakis, C. (2019). Nutrition Care Process (NCP) update part 2: Developing and using the NCP terminology to demonstrate efficacy of nutrition care and related outcomes. *Journal of the Academy of Nutrition and Dietetics*, 119(5), 840-855.

Tam, R., Beck, K. L., Manore, M. M., Gifford, J., Flood, V. M., & O'Connor, H. (2019). Effectiveness of education interventions designed to improve nutrition knowledge in athletes: a systematic review. *Sports Medicine*, 1-18.

Thomas, Erdman, K. A., & Burke, L. M. (2016). Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. *Journal of the Academy of Nutrition and Dietetics*, 116(3), 501-528.

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, 27(2), 237-246.

Trakman, G. L., Forsyth, A., Devlin, B. L., & Belski, R. (2016). A systematic review of athletes' and coaches' nutrition knowledge and reflections on the quality of current nutrition knowledge measures. *Nutrients*, 8(9), 570.

Trakman, G. L., Forsyth, A., Hoye, R., & Belski, R. (2019). Australian team sports athletes prefer dietitians, the internet and nutritionists for sports nutrition information. *Nutrition & Dietetics*, 76(4), 428-437.

Valliant, M. W., Pittman Emplaincourt, H., Kieckhaefer Wenzel, R., & Garner, B. H. (2012). Nutrition education by a registered dietitian improves dietary intake and nutrition knowledge of a NCAA female volleyball team. *Nutrients*, 4(6), 506-516.

Vandelanotte, C., Caperchione, C. M., Ellison, M., George, E. S., Maeder, A., Kolt, G. S., . . . Hooker, C. (2013). What kinds of website and mobile phone–delivered physical activity and nutrition interventions do middle-aged men want?. *Journal of Health Communication*, 18(9), 1070-1083.

VanHeest, J. L., Rodgers, C. D., Mahoney, C. E., & De Souza, M. J. (2014). Ovarian suppression impairs sport performance in junior elite female swimmers. *Medicine & Science in Sports & Exercise,* 46(1), 156-166.

Wardenaar, F. C., Ceelen, I. J., Van Dijk, J.-W., Hangelbroek, R. W., Van Roy, L., Van der Pouw, B., . . . Witkamp, R. F. (2017). Nutritional supplement use by Dutch elite and sub-elite athletes: does receiving dietary counseling make a difference? *International Journal of Sport Nutrition and Exercise Metabolism*, 27(1), 32-42.

Webber, K., Stoess, A. I., Forsythe, H., Kurzynske, J., Vaught, J. A., & Adams, B. (2015). Diet quality of collegiate athletes. *College Student Journal*, 49(2), 251-256.

Wiens, K., Erdman, K. A., Stadnyk, M., & Parnell, J. A. (2014). Dietary supplement usage, motivation, and education in young Canadian athletes. *International Journal of Sport Nutrition and Exercise Metabolism,* 24(6), 613-622.

Zawila, L. G., Steib, C. S. M., & Hoogenboom, B. (2003). The female collegiate cross-country runner: nutritional knowledge and attitudes. *Journal of Athletic Training*, 38(1), 67.

Zoellner, J., Connell, C., Bounds, W., Crook, L., & Yadrick, K. (2009). Peer reviewed: nutrition literacy status and preferred nutrition communication channels among adults in the lower Mississippi Delta. *Preventing Chronic Disease,* 6(4).

Zuniga, K. E., Downey, D. L., McCluskey, R., & Rivers, C. (2017). Need for and interest in a sports nutrition mobile device application among division I collegiate athletes. *International Journal of Sport Nutrition and Exercise Metabolism,* 27(1), 43-49.

6 Appendices

6.1 Participant demographic questionnaire

Please complete the following questions.

Highest educational attainment: Primary □ Secondary □ Tertiary □

Gender: Male □ Female □

Current sport practice:

Date of birth:

Occupation:

Ethnicity:

6.2 **Table 1:** Focus group participant demographics.

Individual level variables	N	%
Age*	22.03	3.97
Highest education level		
Tertiary	11	55
Secondary	9	45
Gender		
Female	15	75
Male	5	25
Main sport		
Badminton	6	30
Tennis	4	20
Athletics	2	10
Rowing	2	10
Water polo	2	10
Football	1	5
Volleyball	1	5
Swimming	1	5
Motorsport	1	5
Occupation		
Student	11	55
Employed	6	30
Athlete	3	15

Ethnicity		
New Zealand European	11	55
Chinese	3	15
Japanese	2	10
Sri Lankan	2	10
South East Asian	1	5
Maori	1	5

*Age is reported as mean±SD

6.3 Focus group questions

Preceding questions

Do you have an interest in learning more about sports nutrition?

What type of nutrition education have you had in the past?

Opening question

- What aspects of sports nutrition are you most interested in?
- If you had to design a sports nutrition education programme, what would It include?
- What would you not include?

Content probes

- Which nutrition topics would you be most interested in learning more about?
- Which nutrition skills-based topics would you include? For example, label reading.
- Which nutrition topics are of no interest to you?

Specific example prompts: Cooking lessons/Healthy eating on a budget/ Adding variety to diet/ Portion size/ Food labels/ Quick & easy meals/ Alcohol

Format probes

Do you have any preferences for how sport nutrition education should be delivered?

- How long would you have the nutrition education programme go for?
- How many times per week?

- How long would a session run?
- Would you include any homework?
- To what extent would you like progress or personal activity to be shared with peers? / Would you include an element of competition within the education framework? Intra/inter group competition?
- What do you consider to be too short and too infrequent for a nutrition education programme?

Teaching strategy/pedagogy probes

- Regarding feedback, monitoring, goal setting, and general support, what would the ideal situation be?
- What elements of teaching would enhance engagement and enjoyment?
- What elements would not be helpful?

Delivery method

- Online delivery versus face to face? (Which delivery mode or modes would you include?)
- What would you not include?

Specific strategy examples: Face to face (1-to-1)/ face to face (group) /Video, e.g., skype (1-to-1) /Video, e.g., skype (group) /Website Mobile apps/ Phone call/ E-mail, peer to peer learning, podcasts, infographics, video clips.

- If you were developing a phone app to include in the nutrition education programme, what features would it have?
- Which features would you not include?

Facilitator probes

Would you like to have an educator as part of the programme?

- What characteristics would you look for in a nutrition educator?
- Educator background preferences? (eg. dietitian, coach, trainer)
- How many educators would you prefer?
- Would you include other staff as educators?
- Would you include any role models/ sporting greats from your sport as educators?
- What characteristics would you avoid in an educator?
- What would keep you engaged?
- What strategies would help with your engagement?

6.4 Researcher journal: focus group reflections

9.9.2020 - 10:00 session.

I thought things went well for my first session. We had a few late comers so that interrupted the flow of the focus group in the initial stages. Having spoken to my assistant, it seemed as though my own personal introduction was too short and that extending it would help in allowing the participants to get to know me better. On a handful of occasions, I noticed myself inserting leading prompts through my interpretations, yet when suggested, the athletes did respond in agreement. I noticed a few differences in personality which led to some people doing most of the talking and some sitting back and listening. I gave a few prompts to the quieter participants, addressing them directly and to good effect, receiving good opinions from them. I believe I did well to apply a longer pause to generate further conversation and this is a technique I should maintain throughout the groups. I must remember to emphasise that time and financial constraints do not need to be considered in the creation of the educational framework, or at least, can be circumvented. Similarly, I need to drive home that it is a discussion, where anything discussed and can be revisited if brought up again if the participants would like to. My understanding of the nutrition sphere from participant reporting: It seemed there was a desire for pre-season and post-season nutrition, offering a specialised programme for the sport and individualised programme for the athlete. There seemed to be conflicting ideas from the participants about the privacy and sense of cohesion during nutrition education programmes. For the individual sports, the people they were in frequent contact with were also their competition, meaning they did not want to reveal too much about their progress during the education programme. Conversely, team sport athletes welcomed the idea of having a group of people share in their information during education sessions. When discussing the phone app, it seemed like a certain sense of privacy was shared by everyone, with the idea being that information was only shared to others when approved by the athlete. It also appeared that the coach was the disciplinary figure for most of the participants and they preferred that their dietary behaviours were not open for the coach to see. In this sense, the coach figure did not come across as a support person. Of further interest was the inclusion of two participants who were attending U.S.A colleges and the conflicting priorities. It seemed that nutrition certainly took a back seat in that environment and all priority was on the athletic season. This meant that their nutrition education programme ideas

were always constrained to these pressures, particularly around time-efficient content and delivery methods.

9.9.2020 - 14:30 session

One very noticeable problem during this session was the slump in energy that came over the group at around the 3pm mark. The younger participants became more disengaged and the conversation did not stay on the current topic and instead, jumped across all areas of interest. Another recurring issue in this session was the personal account of specific conditions and associated struggles. Examples of these were a coeliac disease diagnosis and the difficulty of diversifying the diet under the participants food preferences and a participant with irritable bowel syndrome and her experience with the first-line elimination regimen. These topics were entirely unrelatable for the other participants and did not help ideas to flourish in conversation. They also took up a lot of time, so it is important in future to guide the conversation back to common and relatable ground for all participants. Again, even though I expressed it a number of times, participants still conceptualise the education programme under their current financial constraints, meaning we aren't getting their ideal situation. Question structure will be changed slightly, with teaching styles being presented, then the question stating directly: What kind of feedback would you include in your education programme/to what extent would feedback be included in your education programme? The preceding question will be removed as it has significant overlap to subsequent questions and often has athletes repeating themselves. On a positive note, it was good to see that participants were open to stating their opinions even when they were in conflict with the opinion of someone else. For myself, I think I am good at probing to get a more vivid answer but need to probe a step further to have the participants elaborate more, as opposed to giving my interpretation of their statement.

26.9.2020 - 10:00 session

This focus group was the least forthcoming, thus far. I had planned to ask probing questions without the need to give examples straight away. Yet, having noticed that people were always hesitant to speak, referring to specific examples they had given was needed to begin dialogue. This meant that I had to talk a lot more than I had intended. From the initial questions about keeping up to date with nutrition information and past nutrition education, it was clear that they hadn't had previous experience in nutrition or incorporated it into their training. This made it difficult when thinking of answers to questions as they did not have any points of

reference and were unsure of many areas e.g. nutrition topics. It seemed also with one participant that me reiterating what she had said deterred her, rather than gaining confirmation. This group was also the youngest so this could have potentially contributed to them being more withdrawn, and I saw that they were more likely to talk when one of them had already contributed. One participant was much older than the others and they provided good insight into different aspects. Overall, the group was not afraid to voice their opinion in conflict with the opinions of others. This session also felt very disjointed and the open conversation wasn't flowing half as much as I would have liked.

12.10.2020 - 13:00 session (HJ led).

Practical application was the biggest focus throughout.

Group didn't interact with one another, but more with the moderator.

Questions were overall, well received. Participants did need prompting with a few to get an understanding of what an answer to the question would look like.

Participants had a good background of nutrition and were able to recall their experiences for their answers.

HJ performed well with reflective listening and was thorough, but time conscious.

I could sense that the group was getting a bit tired of the questions

Improvements could have been with patience and people going off track.

Good probing questions to uncover more about areas in which were a little vague. (Direct probing).

Engaged the quieter participants when they weren't saying much.

P13 was thinking hard and seemed disengaged with other participants responses.

All were individual athlete

6.5 Figure 1

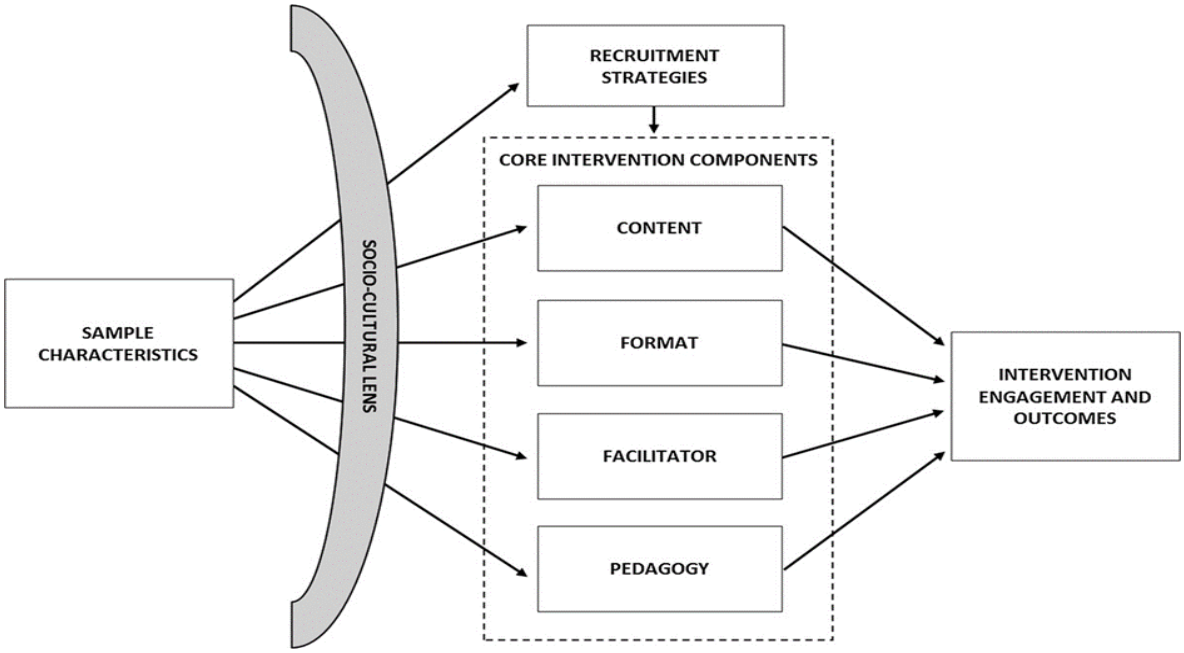

Figure 1: Conceptual model of a socio-culturally relevant approach to the design and delivery of the nutrition education interventions for athletes; sourced from Morgan et al. (2016).

6.6 Table 2: The codebook generated from participants' responses during the focus groups, including number of focus groups (files) and frequency of times mentioned (references).

Name	Files	References
Barriers to education		
Busy schedule	1	2
Lack of access to nutritionist	4	7
Content	1	3
Content characteristics - attributes	0	0
Credible-trustworthy	3	10
Individualised	4	7
Progressive- avoids repetition	2	9
Practical application	0	0

Food preparation skills	4	19
Food purchasing, label reading, grocery shopping	4	11
How to put declarative knowledge into practice	3	12
Curriculum	0	0
Body composition and performance	0	0
Alcohol and training	2	2
How the body metabolises nutrients	1	1
Power to weight ratio	2	6
Skin folds	2	4
Diet intake aligning with athletes' needs	0	0
Adequate amounts	3	5
Female requirements	2	2
Food groups	1	1
Fuel for extended periods-endurance	1	4
Nutrition periodisation	2	5
Nutritional composition of food	1	1
Other	3	7
Recovery	2	4
Dietary trends and restrictions	0	0
Current trends	2	4
Myth busting	1	1
Warnings-disordered eating	1	1
Extension activities	1	1
Food diaries	3	6
Training journal	2	2
Trialling foods	2	3
Supplements	2	9
Unwanted content	3	6
Facilitator characteristics	1	1

Other staff	0	0
Number of facilitators	2	3
One main facilitator with guest speakers	3	6
Other staff involvement	2	4
Coach involvement	4	5
Accountability	2	5
Static involvement	2	5
Role model inclusion	3	3
Against	2	12
For	4	19
Personality	0	0
Character traits- positive and negative	4	41
Open to learn about- interested in their sport	4	9
Qualifications and experience	0	0
Level of experience	4	18
Minimum educational standard	3	10
Format	0	0
Delivery method	0	0
Nutrition education session variables	4	71
Involve parents- nutrition education at a younger age	2	12
Preferred delivery	0	0
Face to face	3	6
One on one- non-face to face	2	3
Online	1	4
Overall structure	3	4
Traditional- group	2	4
Traditional- one on one	2	6
Time of year	4	13
Unwanted delivery methods	3	5

Online element- application-website	3	3
Keeping up to date with sports nutrition information	0	0
No	3	6
Yes	2	3
Past nutrition education	4	36
Previous nutrition education external to sport nutrition educators	0	0
Chef	1	1
Coaches	2	5
Doctor	3	3
Elite athlete	2	3
General dietitian	1	1
General nutritionist	1	3
Naturopath	1	1
Social media	2	6
University	1	2
Pedagogy- teaching techniques	0	0
Enjoyment and engagement	4	16
Interactive	4	12
Feedback and support	4	27
Must have ongoing follow up	2	3
Goal setting and monitoring	4	16
Measurable objective goals	3	6
Unscheduled monitoring	2	4
Unwanted strategy	0	0
Competition	1	2
Intellectually heavy content	1	1

6.7 Coding audit trail: Alterations to the codebook after repeated analysis and critical discussion.

23/10/2020

Moved food diary and journals node into diet history and progress; renaming the node, diet history, journals, and progress. I did this because food diary and diet history are the same concept and the ability to review and see progress is common throughout.

Merged caring node and relatable node into positive character traits node as there was only one reference to these and could be appropriately placed elsewhere with further analysis.

30/11/2020

Large recoding based off supervisor and co supervisor input.

Content contains the two sub nodes, curriculum and content attributes/characteristics. This seems to better define the literal content of the programme, and how the content is to look.

Delivery method was created as a node under format as per the original theoretical structure. Delivery method under format has session duration, frequency, total time, group make-up, and group number grouped together. This to illustrate a more comprehensive picture, succinctly, rather than discussing each topic as a separate node.

The section about phone application preferences has been renamed and enlarged to include general online and website resources. This was done to include various options should an online modality be included in the nutrition education programme.

Combined feedback and support node, as well as goal setting and monitoring as these preferences are similar and complement each other in their implementation.

Nodes under the barriers heading moved to their associated areas to better enhance the reasoning behind preferences. E.g. Moved practical application of education from barriers into skills-based characteristics to show the disconnect in present teaching.

Renamed homework node to extension activities and moved under curriculum node as this seems more of a content feature, rather than a delivery method.

Removed nodes that focused on keeping up to date with sports nutrition and athletes' favourite apps. This is because these are not part of the research's aims and objectives.

Moved interactive node under teaching technique- engagement and enjoyment. As this was mentioned a lot and seems more appropriate under this node.

Moved specific quotes that mention follow ups from the overall structure node to the must have ongoing follow-ups node. More specific to follow ups than describing an overall structure.

3/12/2020

Broke down the unwanted strategy node under pedagogy to its individual content, competition and intellectually heavy content. I did this for further node refinement.

7/12/20

Further defined facilitator characteristics as the themes unfolded. Particularly around coach involvement and the structure of the facilitator team.

11/12/2020

Created more nodes under goal setting and monitoring, withing the pedagogy domain. These ideas were identified upon further analysis of the grouped quotes. They also provide more nuance within this domain, further defining the area.

6.8 Additional focus group quotations

Curriculum

Code: nutrition periodisation
Focus group 1

P5: "…so maybe if it is during the season like what a programme might be for when you're just training, or when you are leading up to competition, or when you're in the competition, but then also like what a programme looks like out of season and like how you might still need to keep bringing in the nutrients you need…"

Code: adequate amounts
Focus group 3

P12: "I guess specifically the quantities of I mean… yeah, ideally tailored to yourself because I think everyone's got different requirements and needs for the different training demands, but yeah what quantities of what is best suited to your training schedule."

Code: current trends
Focus group 2

P11: "…you can just have a bit of an idea of it, let's say …the vegan diet, like what is it? What do you need to look after? And what could be the misconception or what could be the downfalls…"

Code: supplements
Focus group 2

P7: "I'm really interested in supplements like I've got a family member who used to be a body builder and then I see people in my team taking them and kind of know the basics of it but there's so many different brands in so many different types and it's just kind of gets to the point where you're just so overloaded, there's so many options, which ones good, which ones bad, and like you hear so much stuff- like never take that because it's just so bad for you but then you know like I'm really interested in all that stuff and how it affects you."

P9: "Yea, I feel like… me too."

Content characteristics

Code: progressive- avoids repetition
Focus group 2

P9: "…I think it sort of makes people resent it a little [nutrition education programme], not the education part, but because if you're still getting the same stuff it's kind of… you almost automatically, or some people switch off when you have to do it again which is bad but like there's only so many times you can hear it."

Code: credible- trustworthy
Focus group 2

P10: "Yeah in that sense, like the myth busting stuff is important because people need to understand you know what they're hearing from social media is maybe good or bad or whatever it might be."

P9: "Like the person posing with their keto tea or whatever. I guess from a young age, they might not know that maybe that's not what they actually have and things like that. "

Code: individualised
Focus group 4

P13: "That would be one way to describe it really simply is treat people like an individual. Another way would be to take a more functional medicine approach as opposed to a more… what would you call it, previous approach. Like a default evidence-based approach which is just like whatever the science that people said is true must be right for you."

HJ: "Cool. Thank you. So, you're kind of working with the person and what they're going through and then adjusting to how they're going."

P13: "Definitely, yea."

Practical application/skills-based content

Code: how to put declarative knowledge into practice
Focus group 2

P7: "The thing I find really hard is kind of getting what I learned and putting it into practice and actually making those meals and keeping on top of it and that's one thing that I struggle with or like, there's heaps of information out there which is readily available but it's for me, personally, it's just the act of actually putting it in play."

Focus group 4

P18: I feel like you get so much stuff on paper these days and you have to read it, but it's actually like when you have to actually go and do it yourself how is that. So, if someone's like

taking you through it, sort of stepping you through it, but you are the one doing it, you are the one in control. Then when you've got to do it yourself without that person there, it shouldn't be any different. But when you're reading a piece of paper and then you're expected to go and do it, it's like 2 very different things, yeah.

P19: yeah, I feel it would like stick with you more if you're actually doing it rather than if you just read it, you're kind of just like whatever… Do it once and then not again.

Code: food preparation skills
Focus group 3

P12: "Yeah definitely, I reckon. I think that's when you are juggling like studies, training, and work as well, like you are a bit time poor and so having the knowledge on what to cook and how to do it quickly and… kind of make the best use of your time, yeah. if you've got that knowledge then it's quite straightforward. If you don't then it takes longer time to find all the food you need…"

Preferred delivery

Code: face to face
Focus group 2

P9: "I think it's important to meet and see a person just to established that sort of trust or know they're a real person."

Focus group 4

P19: " I prefer in person (P20: Yea) I don't know, I feel like I'm not very engaged when it's online like even right now with my like lectures and stuff, they're over there, I'm not even listening, and you kind of just pause and you do your own thing. But if it's in person, you're obviously not going to like not listen to the person if it's like… If they're in front of you and especially small groups so…"

Code: overall structure
Focus group 3

P14: "I think if it started at the beginning of this three month thing, if you had a just sort of seminar where they just talk about nutrition and generally how it works and what's good for you and then if you had available like a sort of general meal plan, not like a specific meal but like general things to follow every week… yeah, just so you have some education in that and then you just go and kind of do your own thing. Yea. But with the knowledge of what they've told you in the beginning and then you can build off that and change that. But I think in the very beginning it would be beneficial to have just sort of a seminar session where they just sort of talk and teach you."

Focus group 4

P20: "You could do like class sessions for the cooking and like the supermarket run sort of thing. Do that as a group, but then like have the individual ones, yeah because you definitely apply it to yourself and your sport."

Code: traditional- one on one
Focus group 3

P12: "Again personally, I like to see progress and development in that area so like even one on one sessions to help really sort of knuckle down on the details and figure out what really works personally for me and if I'm growing."

Online element – phone application/ website/ social media

Code: communication- notifications and reminders
Focus group 3

P14: "…we use messenger for all of our correspondence to do with training. So, we have like land sessions that we do every week like on the erg machine and stuff. And we'll just take photos of that and send it through to each other and that's how we kind of share that information. We just keep posting and … it gives a little heart react or something. So, I feel like, if you were to do something where you had a group, keeping each other, or just like updating how they're going or like a food diary on messenger or something would be a good one.

Focus group 1

P1: "Notifications maybe. Like something you learnt that day or every day something could just pop up from the app, maybe a little tip or… (P4: Reminders) Yeah, reminders."

Code: Dietary intake- progress and monitoring
Focus group 1

P6: "A graph would be nice too. Because then you can look back and it's like, on this day I ate this and you can count the Calories if you want and then feel how different you are that day with the food you ate."

Code: Easy to navigate, appearance, videos, and photos
Focus group 2

P8: "Or just videos not even live stream. (P7 + P9 agree) I did that F45 and they have the app for it and they had like videos and recipes and stuff how to make it and then like videos and stuff, you know? I found videos more enjoyable because I won't sit there and read paragraphs and paragraphs."

Temporal, demographical, and class attendance variables of the education session

Code: time of year
Focus group 1

P4: "Offseason I definitely think because that's when you have a little more time to actually put these things into practice and because when you get into season, you're just like… You are just going for it, you are trying to focus on your performance but if you have, you know, get the knowledge and everything in preseason then you have time to implement it into your life and hopefully by the time you get to season you're in a good routine and you know more things to help out when you're in season that's [nutrition] kind of not the top priority."
P1: "Yeah, I was going to say preseason so then you can start practicing and then hopefully implement that in your season and then maybe learn a bit of recovery sort of stuff for your post season."

Code: nutrition education session variables
Focus group 4

P13: "Yeah, I agree, something where you have enough time to learn things bit by bit and put them into practice and six months seems like a good amount of time to actually have something transformative as opposed to like a one week session that overloads you…"

Focus group 2

P11: "I think for example if there were 30 close people I think it would still be quite collaborative it really depends on how the dynamic is because like if her team showed up I'm sure they would all give input and it wouldn't be bad. If they were 20 'randoms' I don't think they would be as collaborative as the team."

Focus group 1

P3: "I think for the tracking and stuff it's good to have that smaller group instead of the wider group, but I think maybe the sessions or classes… I'm not so fussed whether it's a big group, or a medium size group, or whatever. I think it's more when it gets to that tracking or accountability or, you know, that kind of stuff, that's probably where, what you said, maybe groups of five."

P5: "You could have breakout groups."

Personality

Code: open to learn about- interested in their sport
Focus group 2

P10:" I think it's better if they show an interest in the sport like, for example, a personal trainer- I'm writing up a gym programme for badminton. If they actually come in and saw the movements that we're performing or let's say the nutritionist that came in and saw like- okay they have 5 to 7 seconds rest between each rally or each average rally is X amount long and understanding those sort of things that would be quite helpful."

Code: character traits- positive and negative
Focus group 1

P2: "I think being open that they're not being judgmental or have an understanding of your sport but also somehow like your... you could talk to them about your lifestyle."

Qualifications and experience

Code: level of experience
Focus group 1

P4: "I think the experience is more important to me than an actual a degree. like you know, I don't want to say anyone can get a degree but like, that's not true, but like having more hands-on experience in different situations I think is far more valuable than, you know…"

Focus group 2

P11"Because like the cases that they work through might be similar to yours, so then they can just pull it out and be like, this actually happened with someone that I've worked with before. Maybe this could help and then they can just take a little bit of another, like, experience that they've come across."

Code: minimum educational standard
Focus group 2

P9: "If I hadn't been recommended them by someone who I trust or by a sporting organisation I'd say at least a university sort of, tertiary, bachelors… the degree. if I didn't have a trustworthy recommendation…"

Number and type of facilitator

Code: one main facilitator with guest speakers
Focus group 1

P5: "Yeah, I like the idea of that how it's like ,you have a main person that you can make a relationship with, like get (P1: yea) personal with them and they're kind of seeing you and I like the guest idea. Maybe someone who's specialized in the area or like they have an interest in something and then pursued it, whether that would be… I don't even know. but you know. So, like they won't necessarily like be your person they'll just talk to you about certain areas you may be interested in learning (P1: Yea, specialized) it or might help you with something."

Focus group 4

P13: "The person you're corresponding with, if we're talking about consistency with that. Some core person the whole way through, that makes a lot of sense, but if you are going have a specific talk on a particular aspect that might become important half way through, you might have to start bringing in specific people to do that kind of stuff."

Code: static involvement (coach)
Focus group 3

P12: "Yeah, I think they are in the loop as opposed to active. they are sitting in on all the sessions but maybe they can chip in if they've got questions ***(MM: Yea)*** *But the advice would come from the nutritionist as opposed to the coach."*

Role model inclusion

Code: role model inclusion
Focus group 4

P13: " I can appreciate that if someone whose past performances I looked up to walked into the room I would be a lot more engaged just emotionally and it's quite empowering so there's something there that's not using them as the primary source of the information that you're teaching but using them in other ways. "

Focus group 2

P8: "…not just hearing that they eat perfectly just hearing that normalising about in-season that they found this really hard or they maybe still don't do well at this. Just sort of normalising the not being perfect part. "

P10: Yeah, I think it almost could be counterproductive because they could relate their experience which in nutrition is not necessarily good for everyone.

Goal setting and monitoring

Code: unscheduled monitoring
Focus group 3

P12: "…So, they can see what you're eating (online food diary) almost in, not real time but as close to. Maybe check in every three weeks and think jeez, that three weeks was pretty rough. Like every couple of days, they could sort of flick you a message and say hey. "

Code: measurable, objective goals
Focus group 2

P9: "Measurable and progressive. Sort, not just going- I want to change this completely like little steps and obviously like achievable goals that aren't just completely out of touch or not sustainable."

HJ: "What would be an example of a measurable goal?

P9: "Like get 'yay' amount of protein per day on majority of days or cut out the majority of this sort of thing."

Code: goal setting and monitoring
Focus group 4

P18: "… having the person that you are learning the information off to be able to check back in with them and yeah I guess it sort of helps you keep accountable… Yourself accountable as well, and then having that check in they would know how you were tracking and I guess how much more information they can give you if you are already struggling with what they've already…"

Feedback and support

Code: must have ongoing follow up
Focus group 1

P5: "… I like the idea of it being like a follow up, so you go back again rather than it being a seminar, you get spoken at, then leave it at that. It's up to you from there on out."

Code: feedback and support
Focus group 3

P12: "I think, yeah it should probably be a two-way street between nutritionist and the athlete because like if the athlete communicates to the nutritionist how they can best be helped, then it makes the nutritionist's job a little bit easier. "

P12: "If not, then actually chat with someone about that. What worked, what didn't, get their advice on how to kind of narrow it down I guess from like the trial and error process."
P14: "I think having sessions would be good but then having someone that you could contact or talk to otherwise…"

Focus group 4

P18: "I think also if there was a one on one, for the person delivering to be able to follow up with an email about… Like clarifying, like what they went over because I know like with my physio, he'll give you like 10 exercises and I'll walk out of there and I'm just like I've got no idea and then you feel awkward to then be like- hey, saw you 2 minutes ago, can you remind me of what you said (P19: That's literally me) and then you see them a week later and they're like how did that go and you're like- fantastic, you know. Like I think having someone like send you… I don't know, I feel like we always have so much on our mind and then I think it would be good for someone to follow up and be like these are the key points we covered and then that way you've made contact so like I feel like I can come back easy enough to be like I've got a question about blah, blah, blah."
P13: "Yeah, I second that, big time."

Engagement and enjoyment

Code: interactive
Focus group 1

P4: " I think for those that like, with studying, it's like when you're always having lectures and stuff it becomes as if that was in the same kind of vein and then it becomes more like a chore like you have to do it. Whereas, if it's something totally different [interactive classroom] it's like, oh this isn't a lecture, like this is more enjoyable like I actually really want to be involved in this and pay attention. "

Focus group 2

P11: "Yeah, so I think a discussion- open questions, yeah great like- why did that work for you or how did you find this. That sort of question, that's fine, like curiosity."

Focus group 4

P13: "I think most people like working with other athletes or other sports people even if they are retired or coaches or something, people find it quite refreshing and enjoyable to kind of hang out. So, I think making it personable is pretty important and is probably the thing that we should lead with, especially if you are targeting at developing athletes. I think a lot of them when you really push it, it's the enjoyment in the social side of things that is actually keeping them in the sport. If that disappears then… whereas if their performance suffers they may or may not go along. If they're not friends with anyone they're doing the sport with, then

they 100 percent will leave, so my first reaction would be to make sure that actually where you lead with is to make it sociable."

HJ: "How would you do that?"

P13: "You would have to be friendly, you would have to have time enough for people to talk and connect and share their experiences and actually feel like if they have a good relationship with other people then in the setting or in the wider course maybe there is like a bigger group to start it off and then you went off into smaller groups or something. That's definitely true with development, I think maybe once you're in early performance, everyone is already committed to their own learning and stuff at that stage, but definitely for younger athletes it's got to be a good time. For most people there's like a million things that they would rather be doing."

6.9 Consent form

What are athletes' preferences regarding nutrition education programmes?

FOCUS GROUP PARTICIPANT CONSENT FORM

I have read, or have had read to me in my first language, and I understand the Information Sheet attached. I have had the details of the study explained to me, my questions have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time.

1. I understand that I have an obligation to respect the privacy of the other members of the group by not disclosing any personal information that they share during our discussion.
2. I understand that all the information I provide will be kept confidential to the extent permitted by law, and the names of all people in the study will be kept confidential by the researcher.

Note: There are limits on confidentiality as there are no formal sanctions on other group participants from disclosing your involvement, identity or what you say to others in the focus group. There are risks in taking part in focus group research and taking part assumes that you are willing to assume those risks.

3. I agree to participate in the focus group and online survey under the conditions set out in the Information Sheet attached.

Declaration by Participant:

I _____ hereby consent to take part in this study.

Signature: _____ Date: _____

6.10 Information sheet

What are athletes' preferences regarding nutrition education programmes?

INFORMATION SHEET

We would like to invite you to take part in this study which aims to explore athletes' preferences for nutrition education. Please read this information sheet carefully before deciding whether or not to participate.

Researcher Introduction

Matson McCauley is a postgraduate student in the School of Sport Exercise and Nutrition at Massey University and is conducting this research as part of his Master of Science in Nutrition and Dietetics. Dr Kathryn Beck is a New Zealand Registered Dietitian and Associate Professor in Nutrition and Dietetics in the School of Sport Exercise and Nutrition at Massey University. Co-supervisors include Dr Claire Badenhorst, Dr Bevan Erueti, and Associate Professor Gary Slater, from Massey University, Albany; Palmerston North, and the University of the Sunshine Coast, respectively.

Why is this research important?

Nutrition is an important part of optimising sporting performance and support in training. Current dietary trends among athletes show suboptimal diets during both the off season and during season competition. Sports nutrition education may help improve the dietary intake of athlete to meet health and performance goals. This study will work with high performing athletes living in Auckland, New Zealand to identify an effective participant-guided sport nutrition education framework for athletes. Research will use a mixed methods approach, gathering information from focus groups to then inform an online survey which focus group participants will also complete.

Who are we looking for?

We are looking for a minimum of 20 athletes to participate in this study.

To participate you should:

- Be over 16 years of age.
- Compete in your chosen sport at national or international level.

You will be given a $40 shopping voucher for your time.

What is going to happen?

Participation in this study involves attending an initial focus group session with the researchers which will take approximately 1 hour and will be audio taped. This focus group will involve up to 6 athletes and include broad questions on sports nutrition education, your views on this and what preferences you have for teaching strategy, content, format, and facilitator characteristics. Once all focus groups have been conducted and the data analysed, an online survey will be created using athletes' responses from the focus group findings. We will ask you to complete the survey online. This will take no more than 30 minutes. The focus group will be held at Massey University Albany campus or a local sports organisation and arranged to a time that suits all potential participants. Alternatively, all focus groups will be held digitally, using Zoom software for video calling. All involved will attend the call from a suitable location of their choosing.

What will happen to the information you provide?

All information collected during this study will be confidential and will be used only for the purposes of this project. To protect your privacy your real name will not be used anywhere. Instead we will use an anonymous ID code to label any information relating to you such as the transcribed information from the audio-taped interview, or any reports or articles produced. Access to any information that links your personal details to the ID code will be stored in a locked filing cabinet at Massey University and restricted to members of the research team.

After completion of the data collection, the study findings will be written up as part of the main researcher's Master of Science Nutrition and Dietetics thesis project. Results of this

project may be published or presented at conferences or seminars. No individual will be able to be identified.

All audio recordings, transcripts, and online surveys will be stored electronically in a locked file within a password locked computer and duplicate compact disc and paper copies will be stored in a locked filing cabinet at Massey University, Albany. Any raw data on which the results of the project depend will be retained in secure storage for 5 years, after which it will be destroyed.

A summary of the project findings will be available to all study participants. All participants will be sent this information via email or a personal letter.

What are the benefits and risks of taking part in this study?

- You will receive a brief report summarising the main findings of the project via mail or email.
- You will be given a $40 shopping voucher for your time in taking part in this research.
- The principal benefit of taking part in this study is that you will contribute to a study that will potentially inform future planning and development of nutrition education programmes for athletes.
- It is not envisaged that there will be any discomforts or risks to the participants as a result of participation.

Who is funding the research?

The School of Sport Exercise and Nutrition at Massey University.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study at any stage;
- ask any questions about the study at any time during participation;

- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- have any audio recording of yourself returned to you, electronically, via e-mail;
- be given access to a summary of the project findings when it is concluded.

Project Contacts

If you have any further questions or concerns about the project, either now or in the future, please contact:

Matson McCauley, MSc student -
Human Nutrition and Dietetics School
of Sport Exercise and Nutrition,
Massey University
Email – [redacted]
Phone: [redacted]

Dr Kathryn Beck, NZRD
School of Sport Exercise and Nutrition,
Massey University
Email – k.l.beck@massey.ac.nz
Phone (09) 414 0800 ext 43622

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 x 85271, email humanethics@massey.ac.nz

Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern B, Application SOB 20/02. If you have any concerns about the conduct of this research, please contact Dr Gerald Harrison, Chair, Massey University Human Ethics Committee: Southern B, telephone 06 356 9099 x 83570, email humanethicsouthb@massey.ac.nz

Thank you for considering participating in this study.