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Elite Athlete Preferences for Nutrition Education

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Abstract

Background: Nutrition education (NE) has the potential to be a catalyst for athletes to optimise their diet and consequently enhance performance. However, very little research has been undertaken to understand what athletes would like in a nutrition education programme (NEP). The present study aimed to investigate the preferences of elite athletes for a NEP with a specific focus on preferences for pedagogy, content, format, and facilitator.

Methods: Athletes ($n=124$, median (IQR)=22 (9) years, female 54.8%) competing at a national or international level from 22 sports, and living in New Zealand ($n=101$, 81.5%) and Australia ($n=19$, 15.3%) participated in an online survey developed by the researchers. Responses (from descriptive Likert scales, ranking of preferences, single and multiple answer multi-choice questions) were analysed using descriptive statistics.

Results: Athletes were *very* (45.2%) or *extremely interested* (37.9%) in NE and value a NEP that is engaging (96.0%) and credible (91.1%). Teaching techniques considered *extremely effective* for learning were life examples (47.6%), applied hands on activities (30.6%), and discussions with the facilitator (30.6%). Setting personal nutrition goals was important to most athletes (83.9%), along with two-way feedback with the facilitator (75.0%). General nutrition topics considered an *essential* priority for NE were energy requirements (52.4% of athletes), hydration (52.4%), and nutrient deficiencies (41.9%). Performance topics considered *essential* were recovery (58.1%), pre-exercise nutrition (51.6%), nutrition during exercise (50.0%) and energy requirements for training (49.2%). Adapting meals for training requirements (37.9% of athletes) and behaviour change techniques (26.6%) were considered *essential* nutrition-related life-skills. Credible content was important (91.1%), and most participants wanted some repetition of topics (69.4%). Athletes' top-ranked setting preferences were 'in person group sessions' (mean rank 4.66), followed by a 'mixture of in person one-on-one and group sessions' (mean rank 4.55), and 'one-on-one sessions' (mean rank 4.48). For both online and in person group sessions most athletes wanted to share NE with athletes of the same sporting calibre (61.3%) and with 6-10 others (in person 44.4%, online 31.5%). Preferred session duration was 31-60 minutes (in person 63.7%, online 58.9%) and held monthly (in person 36.3%, online 38.7%). A performance dietitian or nutritionist was the top-ranked facilitator (mean rank 4.09), followed by a sports/exercise physiologist (mean rank 4.07), and an experienced athlete in the sport (mean rank 3.69). Preferred facilitator traits were credibility (73.4%), experience in sports nutrition (76.6%) and knowledge of the sport (85.5%).

Conclusions: Athletes were interested in NE and valued an engaging NEP that included kinaesthetic, aural, and visual teaching techniques. Athletes preferred 'in person group sessions' for the delivery of NE. Preferences were that content be credible, and covered a mixture of general, performance and

skills-based nutrition topics, such as adapting meals for sporting requirements. Credibility of the facilitator was important, as was experience in sports nutrition and knowledge of the athlete's sport. Further research is needed with athletes at different levels and across all sports to further understand athletes' preferences for NE.

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Abbreviations

Abbreviation	Meaning
AFL	Australian Football League: the competition of Australian rules football
AIS	Australian Institute of Sport
ATP	Adenosine triphosphate
COM-B	Capability, opportunity, and motivation behaviour model
g/kg/d	grams per kilo of body weight per day
HPSNZ	High Performance Sport New Zealand
NE	Nutrition education
NEP	Nutrition education programme
NIN	National Institute Network
NCAA	National Collegiate Athletic Association
NSO	National Sporting Organisation
USA	United States of America
VARC	Visual, aural, read/write, kinaesthetic
WHISPA	Healthy Women in Sport: A Performance Advantage

1 Chapter One: Introduction

1.1 Scope and justification for the research

Nutrition for the athlete is a way to manipulate sport specific body mass, optimise body function, and offers the athlete the ability to regulate macro and micronutrient intakes to meet their needs (Thomas et al., 2016). While sports differ greatly in competition characteristics, all athletes share the common goal of minimising fatigue, and maximising recovery and adaptation from training in order to improve their performance (Burke & Hawley, 2018).

Athletes need to consume enough energy to meet not only energy requirements from daily living, but also the additional energy requirements of their sport and training. In addition, adolescent athletes have higher energy and nutrient requirements to maintain growth, and in female athletes establish healthy menstruation (Burke & Deakin, 2015). To help ensure these energy demands are met while maintaining high training loads, nutrition education (NE) for athletes most frequently focuses on total macronutrients and hydration maintenance (Tam et al., 2019). Other topics of importance such as body composition, supplement use and micronutrients such as iron, vitamin D, calcium, and antioxidants are less recognised in athlete education programmes (Tam et al., 2019; Thomas et al., 2016).

Several factors influence an athlete's food choices. These include peer pressure, family meals, cost, and time constraints, along with the athlete's social and physical environment (Bentley et al., 2019; Heaney et al., 2008; Stokes et al., 2018). The age, stage of life (for example living with parents, full time study and/or employment) and level of sponsorship and/or funding available to the athlete, can all contribute to attitudes around food and eating (Heaney et al., 2008). Athletes may experience pressure from their coaches, peers, family, or self to follow one of many restrictive fad diets prevalent in the general population (Heaney et al., 2008; Stokes et al., 2018). Misinformation and beliefs regarding nutrition coming from these multiple sources can lead to harmful health and physical outcomes (Wansink, 2006). Furthermore, whether the athlete is training in a power, endurance, and/or an aesthetic-related sport will further increase their requirement for sport-specific nutritional education.

An athlete's food choices are also influenced by baseline nutrition knowledge (Heaney et al., 2008). By offering high quality NE, sports dietitians, coaches, and team management staff can have a stronger impact on the food choices made by their athletes. Unfortunately, studies show athletes have a relatively low level of baseline performance nutrition knowledge and are following sub-optimal diets

(Burke et al., 2001; Spendlove et al., 2012). Research comparing the nutrition knowledge of athletes to non-athletes has predominantly been undertaken in collegiate athlete population groups (Heaney et al., 2011). Some studies observe that elite-level athletes do have a greater general nutrition knowledge than non-athlete groups (Heaney et al., 2011). However, the authors recognise this evidence is weak and there are notable limitations to these studies. Given the positive influence food and nutrition has on physical and mental performance, a poor baseline nutrition knowledge is of large concern for athlete groups making informed dietary choices, particularly given to the nutritional demands of elite level performance.

In a systematic review evaluating the effectiveness of NE programmes, 84% of the studies reviewed revealed a significant improvement according to the individual studies standards, in athletes' nutrition knowledge following an intervention programme (Tam et al., 2019). Despite these findings, the poor translation of knowledge to improvements in diet quality are consistently shown in the few studies that have followed up with an assessment of dietary intake (Boidin et al., 2020; Spronk et al., 2015). Concerns of nutrition professionals prior to NE in athletes are primarily around inadequate energy intake, particularly in female athletes (Boidin et al., 2020; Mountjoy et al., 2014). A systematic review of 18 studies comparing energy intake pre and post NE intervention found only half of the groups had a significant change in energy intake (Boidin et al., 2020). Unfortunately, within these studies, it is difficult to draw conclusions on the effect of the NE interventions on dietary intake given the vast delivery methods, and the quality of the validation in the dietary assessment tools used.

Traditionally, NE for athletes is designed by coaches or sports nutrition professionals. Few studies investigate what athletes want in their nutrition education programme (NEP). Some parameters around what the athlete wants in their NEP have begun to be explored. For example, in a sample of female athletes who received a combination of education in energy balance and cognitive behavioural therapy, the athletes responded in exit interviews that the most helpful intervention items included macronutrients, snack options, meal planning, recovery, and the value of strength training (Buffington et al., 2016). In a more recent study exploring NE preferences of New Zealand elite athletes using focus group sessions, popular content preferences were around nutrition periodisation, as well as the need for more nutrition-related life-skills education (McCauley et al., 2021). Whilst research into athletes' preferences in NE is still in its infancy, some studies have looked directly at preferences in non-athlete groups (Ashton et al., 2017; Crawford & Ball, 2007). Young men wishing to improve their nutrition intake voiced that NEP delivery needed to be flexible with a combination of both in person, online, and mobile application components (Ashton et al., 2017). Here content delivered via a website was

the most favoured method, and face-to-face group sessions with facilitators who were engaging and positive in their NE delivery (Ashton et al., 2017). Being able to quantify specifically what is important to elite athletes' in their NEP is an important next step in this field of research.

Designing an optimal NEP for athletes requires consideration of a number of factors including the content, format, facilitator, and the overall pedagogy (Morgan et al., 2016). When considering the content and the curricular items to include, appropriate evidence-based topics should aim to be incorporated. This may include country specific healthy eating guidelines for active individuals, energy requirements for sport, body composition, hydration, and nutrition-related life-skills (Patton-Lopez et al., 2018; Philippou et al., 2017; Wong et al., 2018). It is important to consider format, including how long the NEP runs for, and how often the sessions or lessons are held. The format of previous NEPs varies in the literature, with factors such as the sports competition season and training camps often influencing their duration and frequency. The question of who is best placed to deliver NE to the athlete (e.g., coach, dietitian, strength coach), also varies in the literature with pros and cons for each facilitator affected by relationships, availability, and finances. Various forms of teaching include the following: face-to-face delivery in large and small group lectures, individual counselling, interactive group workshops or activities, mixed method modalities such as lectures plus a handout or lectures plus an individual consultation, and finally technology-based pedagogies. For effectiveness, these factors must all be considered within the overall scope of the NEP.

There is a need to investigate athletes' preferences for the teaching of NE. While this applies to all athletes (elite, sub-elite, and recreational), the high performance and training demands of elite competition require particular attention. Even if these athletes are already provided with nutrition support services, it is important that the information is well targeted and delivered in a way that is understood by the athlete for application of positive nutrition behaviours. Such knowledge will contribute to the design of future NE interventions to deliver maximum benefits in knowledge and, more importantly, translation to an optimal athlete dietary intake.

Furthermore, the knowledge of athlete preferences will support nutrition professionals, researchers, and support staff on how NEPs can be designed and implemented to provide the most benefit and value to elite athletes.

This research aims to understand elite athlete preferences for NE including content, format, facilitator, and pedagogy. With new advances in mobile applications, webinars, and online courses, the research

will endeavour to gain qualitative insight on whether traditional seminar formats are the most effective way to educate and engage athletes on nutrition for their sport.

1.2 Research aims and objectives

Aim: To quantitatively identify elite Australian and New Zealand athlete preferences for nutrition education delivery.

Objectives:

To develop a survey to assess athlete preferences for nutrition education delivery.

To quantify preferred nutrition education *pedagogy* among athletes.

To quantify preferred nutrition education *format* among athletes.

To identify the salient topics and specific *content* of a nutrition education program as preferred by athletes.

To quantify nutrition education *facilitator* preferences among athletes.

1.3 Structure of thesis

This thesis comprises of four chapters. This initial chapter outlines the purpose of the study, with an overview of the background of the elite athlete population and the concept of preferences in a NEP. The second chapter of the thesis discusses findings from a thorough search of the literature, setting the scene for the importance of quality nutrition intake in elite athletes, nutrition knowledge and diet quality, and what is already known regarding athlete preferences and the effectiveness of various components of a NEP. Athlete preferences for each of the study primary objectives including preferred pedagogy, format, content, and facilitator for a NEP are explored in depth. Chapter three presents a manuscript including an abstract, introduction, methodology, results, discussion, strengths and limitations, and conclusion of the findings from the elite athlete's NEP survey. The final chapter of the thesis focuses on the concluding recommendations from the findings of the survey, along with areas where further research is needed.

1.4 Researchers' contributions

Table 1.1 Researcher's contributions to this study

Researcher	Contribution to thesis
Hayley Jenkins	MSc Nutrition and Dietetic Student Primary author of the thesis. Responsible for development of the survey, Massey University ethics application, development of study information sheet, recruitment for survey pre-testing, entering survey into Qualtrics, recruiting participants, managing data collection, data entry, statistical analysis, interpretation of results, and writing the thesis.
Associate Professor Kathryn Beck	Massey University MSc primary academic supervisor Conceptualised the study. Provided guidance for the ethics application, survey design and development. Provided feedback on all elements of the thesis.
Dr Claire Badenhorst	Massey University MSc co-supervisor Assisted with survey development. Provided guidance and feedback on all elements of the thesis.
Matson McCauley	Massey University MSc Nutrition & Dietetics Graduate Conducted preliminary qualitative research to guide the creation of this survey.
Associate Professor Gary Slater	University of Sunshine Coast co-supervisor Provided feedback on survey drafts and aided with athlete recruitment in Australia.
Dr Janelle Gifford	The University of Sydney co-supervisor Provided feedback on survey drafts.

2 Chapter Two: Literature Review

2.1 Introduction to the literature

In a world saturated with information, accessing effective and quality nutrition information for the athletic community could not be more important. The athlete is continually looking for a performance edge to set them apart from their competitors, and optimal dietary intake supported through quality nutrition education (NE) is a key part of this. Nutrition provides the foundation for cellular activity for energy production and performance. Quality nutrition allows the athlete to maintain a high level of training intensity and training volume consistency that is required to make performance gains. Nutrition information is pushed on the athletic population by social media outlets, news stations, marketing companies, supermarkets, coaches, peers, and family. Well-designed nutrition education, that is well received by the athlete is an important means to better athletic performance through sustainable eating behaviours that will support the athlete in their sporting career.

Whilst science is providing important nutrition information for the athlete, learnings may come from successful elite athletes whose practices challenge the guidelines and encourage ongoing research to further understand practices and develop recommendations in nutrition for athletic performance (Burke & Hawley, 2018). The aim of this literature review is to cover why nutrition is important for athlete performance; the diet quality of elite athletes and barriers often faced by athletes in making healthy food choices; levels of athletes' general and sports nutrition knowledge and its causal effect on diet quality; sources of nutrition information for athletes; the importance of quality NE for elite athletes; and preferences in NE including learning style preferences. The review also considers what are effective NE methods and what components make up a successful nutrition education programme (NEP) that promotes adherence to dietary change. Finally, the review explores the preferences and success of each of the four key components of a NEP which are the content, format, facilitator, and pedagogy.

The literature search utilised five electronic databases including Discover, SPORT Discus, PUBMED, SportDISCUS, Web of Science and Scopus to investigate studies published along the designated timeline from 2011 to 2021. Key words used in the searches were various combinations of 'nutrition', 'education', 'teach', 'pedagogy', 'program*', "elite athlete", "professional athlete", 'athlete*', 'survey', 'questionnaire', and 'preference*'. Citation review of relevant systematic reviews by Boidin et al. (2020); Heaney et al. (2011); Tam et al. (2019) was undertaken to further identify relevant publications.

2.2 Importance of nutrition for athletic performance

Exercise is demanding on the body, requiring more energy than that required in the resting metabolic state (Burke & Deakin, 2015). This is especially so for those training at the intensity and duration required of the elite athlete. To consistently manage this training load, the body requires constant fuel supplied through dietary intake to maintain a high level of power, strength, endurance, and focus, depending on the sport. Therefore, quality and quantity of nutrition are important factors to consider to ensure the athlete has sufficient energy to perform, recover and adapt from the daily training load, and maintain normal physiological processes.

Nutrition is important in all sports; team, sprint, endurance, skill, and/or weight focused, to maintain peak performance output and to counter both mental and physical fatigue. Whether the athlete achieves their nutritional requirements will depend on their training schedules, competition, and personal preferences. The timing of the athlete's macronutrient intake around exercise can be broken down to pre-exercise nutrition, nutrition during exercise, and post-exercise nutrition (Kerksick et al., 2017).

In field or court-based team sports, athletes undergo repeated and often prolonged periods of high-intensity running, in combination with the sport's unique skill. The muscles are reliant on a supply of glucose for power output and maintaining a high work rate, particularly in events lasting more than 60 minutes in duration (Burke, 2010; Williams & Rollo, 2015). Without appropriate pre-event nutrition 1-4 hours prior to the competition, the athlete runs the risk of having inadequate muscle glycogen stores, hydration, and electrolyte levels necessary for peak performance (Burke & Deakin, 2015; Thomas et al., 2016). The nature of the event or personal preference of the athlete (e.g., not wanting a full stomach before the event) may not allow for a substantial meal prior to the game/match or event. However, sport nutrition guidelines would still suggest that it is important for athletes to focus on carbohydrate intake prior to the upcoming exercise to ensure adequate fuel provision for the given exercise event (Burke & Deakin, 2015). In long distance endurance events (running, swimming, cycling) and team sports with intermittent high intensity efforts, adequate carbohydrate and fluid intake for the individual based on the session intensity, duration and individual gastric tolerance is recommended to ensure performance is maintained (Costa et al., 2019; Kerksick et al., 2017; Thomas et al., 2016). Recovery from exercise will depend on how well the athlete's nutritional needs have been met before and during exercise, particularly fluid losses for those competing with an elevated core body temperature, protein for muscle protein synthesis, and glycogen as already mentioned (Burke & Deakin, 2015). If the brain is not provided adequate fluid and carbohydrate to maintain

hydration and glucose levels, perceptions of fatigue are heightened, and the athlete is likely to slow down significantly (Burke & Deakin, 2015). For athletes who require high levels of focus e.g., driver-athletes, fatigue will increase the athlete's perception of fatigue from physiological stressors such as the car control and their posture at high g-forces, taking their focus away from the technical aspect of their sport (Reid & Lightfoot, 2019). Sports with specific weight and body composition requirements inhibit the feasibility of having one size fits all dietary recommendations (Sundgot-Borgen et al., 2013). Athletes competing in sports with aesthetic or weight-class needs such as combat sports, light weight rowing, gymnastics, and weightlifting unfortunately often undertake in abrupt weight loss behaviours in the lead up to competition that can prove detrimental to not only their performance, but also their overall health, and wellbeing (Thomas et al., 2016). Nutrition strategies for weight management are important for how the athlete feels and performs in competition and should be done strategically as part of their overall training programme in order to maintain desired muscle mass (Thomas et al., 2016).

2.3 Diet quality

2.3.1 Athletes' nutrition guidelines/recommendations and dietary intake

The athlete has specific nutrition requirements in addition to those recommended for the general population to meet the demand of increased energy expenditure. Despite this, elite Australian athletes are not consistently meeting their nutrition needs when compared to the guidelines of the general adult population (Capling et al., 2020; Spronk et al., 2015). Meeting energy, macronutrient and key micronutrient intakes through a nutrient rich diet is not only important for sporting performance in competition and training, but also important in avoiding injury, illness, and improving mood (Mountjoy et al., 2014).

For the athlete to perform well in their sport, and meet their energy needs for daily living, health and growth, it is imperative they obtain an adequate intake of energy from their diet (Mountjoy et al., 2014). The athlete's energy requirements can be estimated on an individual basis factoring in age, gender, activity level, and body size (Burke & Deakin, 2015; National Health and Medical Research Council et al., 2006). In a systematic review by Jenner et al., (2019) reviewing the dietary intake of both professional and semi-professional team sport athletes, 8 of 21 studies provided evidence for athletes not meeting their energy requirements. Similarly, at least 7 of the 22 studies in a systematic review by Boidin et al. (2020) found athletes to have low energy intake prior to the intervention. Studies needing to quantify the athlete's nutritional intake are likely to suffer from limitations such as under-reporting with the use of food diaries (Cole et al., 2005; James et al., 2017). It is therefore

difficult to make comparisons between studies due to the heterogeneity of dietary assessment methods (Capling et al., 2020; Shriver et al., 2013; Spronk et al., 2015).

The athlete's energy needs are met through an appropriate balance of carbohydrates, proteins, and fats. Maintaining adequate glycogen stores for fuel utilisation is key for athletic performance in intensity, skill, and concentration sports (Thomas et al., 2016). As such, dietary carbohydrate intake plays a key role in minimising fatigue and facilitates provision on exogenous blood glucose during activity and source of carbohydrate to replenish muscle glycogen post-exercise. Carbohydrate recommendations vary depending on the intensity and duration that the athlete is training or performing at, whether it be a skills-based sport (lower carbohydrate requirements) through to extreme sports where periods of high intensity are greater than four hours per day (higher carbohydrate requirements) (Thomas et al., 2016). Recommendations for moderate to high intensity programmes ranges from 5- 10 grams per kilo of body mass per day (g/kg/d) (Thomas et al., 2016). Numerous studies report athletes failing to meet the guidelines for dietary carbohydrate intake (Abood et al., 2004; Baranauskas et al., 2015; Burke et al., 2003; Burke et al., 2001; Condo et al., 2019; Elias et al., 2018; Heikura et al., 2017; James et al., 2017; Jenner, Devlin, et al., 2019; Masson & Lamarche, 2016; Molina-Lopez et al., 2013; Nowacka et al., 2016; Rossi et al., 2017; Shriver et al., 2013; Valliant et al., 2012). Where energy needs are not being met through carbohydrate sources, fat or protein often will take its place in the athlete's diet. Athletes whose carbohydrate intake does not satisfy the athlete's baseline recommended requirements end up (intentionally or not) following a high fat low carbohydrate macronutrient distribution (Elias et al., 2018; Molina-Lopez et al., 2013; Nowacka et al., 2016; Rossi et al., 2017; Valliant et al., 2012). In a study where athletes' goals were to increase lean mass, the athletes who received no NE decreased their intake of carbohydrates and increased their fat intake, compared with athletes who received nutrition counselling who significantly increased their carbohydrates intake compared to baseline (Garthe et al., 2013). Similar findings were seen in Malaysian team athletes (Elias et al., 2018). Here, athletes who received the intervention significantly increased their dietary intake of carbohydrates, whilst a significant decrease in carbohydrate intake was observed in control group athletes who did not receive NE (Elias et al., 2018). In systematic review of the diet quality in team sport athletes by Jenner, Buckley, et al. (2019), the author points out an alarming number of athletes sacrificing carbohydrate foods for protein and fats. A longitudinal study investigating dietary intakes of adolescent elite female rowers found a significant decrease in both carbohydrate and calcium intake over the course of nine months without a NE intervention (James et al., 2017). This distinctive response for athletes to continually fail to meet their carbohydrate requirements shows a strong need for more effective guidance and education to

athletes and their support members on the importance of carbohydrates for sporting performance, and practical strategies on how carbohydrates can be incorporated into dietary habits.

The remodelling of skeletal muscle following training is enhanced by the increase in skeletal muscle turnover (Burke & Deakin, 2015). For muscle protein synthesis to occur optimally with training, adequate dietary protein is vital to facilitate the remodelling of skeletal muscle. It is traditionally recommended that athletes require 1.2-2g/kg/d of protein taken regularly throughout the day (Kerksick et al., 2017; Thomas et al., 2016). It has been reported that most athletes do meet or exceed these recommendations, with ranges in elite athletes from various sports being reported from 0.9-2.2g/kg/d (Burke et al., 2003; Elias et al., 2018; Martinelli, 2013; Nowacka et al., 2016). Athletes not only achieving but exceeding their protein needs is supported by findings from a systematic review with 14 of 20 studies finding professional and semi-professional team sport athletes exceeded recommendations for protein (Jenner et al., 2019). In a systematic review by Boidin et al. (2020), 41% of the studies that reported athletes' protein intake found it to be inadequate at below 1.1g/kg/d. All these studies with findings of inadequate protein intake were in female only athlete populations (Boidin et al., 2020). Though protein is a crucial nutrient in the athlete's diet, its importance may vary within a NEP depending on the sport, and gender of the athlete audience.

Carbohydrates (blood glucose and muscle glycogen) and fat are key substrates that are utilised in the mitochondria to produce ATP via oxidative phosphorylation (Thomas et al., 2016). At rest fat is primarily utilised for ATP production, due to the energy density of the substrate (Maughan & Gleeson, 2012) and the large availability of the substrate even in the leanest of individuals. In comparison to muscle and liver glycogen stores (~800g), fat stores may be 5-10 kgs or more (depending on the individual), therefore athletic populations have considered high fat diets as a valid option of preventing carbohydrate depletion. High fat diets have been shown to increase fat oxidation in athletes of various intensities, however the benefits in athletic performance are yet to be substantiated. Due to the growing interest in this dietary approach (low carbohydrate, high fat) there appears to be more athletes consuming more fat (and less carbohydrate) than the amounts recommended for performance (Elias et al., 2018; Garthe et al., 2013; Molina-Lopez et al., 2013; Rossi et al., 2017; Valliant et al., 2012). Fat intake recommendations for athletes should be individualised, according to the athlete's level of training and their body composition targets (Thomas et al., 2016). If the athlete has no specific targets for training or body composition, it is recommended to follow guidelines recommended for the general population (Thomas et al., 2016). In one study, following NE given to team sportsmen, a significant improvement in the athlete's total energy intake was achieved

through increased high fat and high protein foods, rather than through carbohydrate intake (Elias et al., 2018). These observations support findings for a general misbelief in the athlete population that protein is the primary fuel for muscle movement (Heaney et al., 2011). This misbelief may be linked to athletes' intake of fat from consumption of animal protein foods and lessening the desire to consume carbohydrate foods for performance (Heaney et al., 2011). Along with the role of dietary fat in performance nutrition, more clarification is likely needed in education around dairy fat sources and in particular food sources of saturated and unsaturated fats (Devlin & Belski, 2015).

Exercise increases metabolic rate, increasing core body temperature which the body responds to with sweating to cool itself. Fluid losses from sweat and respiration are important for the athlete to replace, to minimise dehydration. Conversely, it is important not to over drink to avoid hyponatraemia. Both states have serious consequences to performance and wellbeing (Thomas et al., 2016). Current recommendations in sport suggest that prior to exercise athletes should aim to consume 5-10 ml of fluid per kilogram of body weight, using urine colour to guide hydration levels (Thomas et al., 2016). Australian elite athletes scored well in water intake from a food frequency questionnaire assessing the diet quality of 101 top athletes (Spronk et al., 2015). Fluid intake may be ignored in many studies investigating athletes' dietary intake, possibly due to the unique assessment required to measure hydration status, and the variability of intake depending on environmental, sport specific, personal body composition and physiological variables influencing fluid requirements (Boidin et al., 2020; Zubac et al., 2019).

Micronutrients such as iron and calcium are often needed in higher amounts due to the extreme stress posed on the athlete's body during training and competition. Micronutrients become even more vital to athletes who are restricting intake to meet weight targets and menstruating female athletes with recurrent blood losses. Iron is an important mineral for the transportation of oxygen throughout the body. Athletes at risk of low iron levels may need to aim for higher intake levels than the recommended daily amounts for age and gender (Thomas et al., 2016). An unfortunate number of studies show athletes failing to meet their iron needs through diet, particularly 'at risk' athletes such as endurance runners and menstruating females as seen in systematic review by Boidin et al. (2020). Calcium is a mineral well known for its role in bone health, yet studies assessing athletes' dietary intake have noted this to be inadequate (Anderson, 2010; Baranauskas et al., 2015; Boidin et al., 2020; Condo et al., 2019; James et al., 2017). Calcium also has an important role in nerve transmission, muscle contractions and blood clotting (Thomas et al., 2016). An athlete restricting their dietary intake to meet weight loss goals may forfeit calcium rich foods, consequently falling short of the 1,500mg/day

requirements (Mountjoy et al., 2014). In one NE intervention in female university athletes, all participants met macronutrient requirements both at baseline and three months later after the intervention, however their intake of calcium and iron was inadequate following the NE intervention (Collison., 1996). The researchers noted this may be due to the timing of the athletic training seasons when data was collected. Athletes consumed more during the competition season (baseline) and thereby met their micronutrient needs with the additional intake (Collison., 1996). There is a clear importance for education on how athletes can include good sources of key minerals for performance in their diet both in-season and in the off-season.

2.3.2 Barriers

Understanding the athlete's barriers and enablers to change are vital in creating an effective NEP that brings about positive behavioural change (Bentley et al., 2021). Barriers faced by the athlete are well documented in the literature. Managing training demands, extra therapy to support performance, travel, work, and sometimes study, the athlete often has a busy schedule (Eck & Byrd-Bredbenner, 2019; Garthe et al., 2013; Heaney et al., 2008; McCauley et al., 2021; Rossi et al., 2017). This can make time one of the most common barriers to improving nutrition practices.

Barriers linked to finances, time constraints, and social situations are more commonly noted in younger athletes, under 30 years of age (Bentley et al., 2021; Heaney et al., 2008; Rossi et al., 2017; Stokes et al., 2018; Thurecht & Pelly, 2020). How much value the individual athlete has for nutrition and quality food choices will influence how much cost is viewed as a barrier, as is seen in professional, elite, and college athletes (Birkenhead & Slater, 2015). Time management, meal planning and cost as barriers are often presented as a 'chicken or the egg' scenario. Basic food skills are often a key part of NE, including meal planning and time management, opening the opportunity to save money on more costly eating out and last-minute food decisions (Parks et al., 2016; Wong et al., 2018).

Barriers that relate more to the athlete's lived experience also influence their food choices. This includes personal preferences such as taste, and how particular foods make them feel. For example, gut discomfort is something that is noted to influence the food choice in athletes across many sports (Thurecht & Pelly, 2020). Temptation to steer away from foods supportive of performance goals can be augmented in social situations, with peers and advertisements in the media increasing the desire for the taste and pleasure experienced with the consumption of less nutrient dense foods (Stokes et al., 2018). Food preferences are likely be further influenced by an important competition, or by body composition goals (Birkenhead & Slater, 2015).

In focus group discussions, elite athletes have voiced their experiences of hedonistic eating, specifically how a poor training session influences their food choices, by either positively reinforcing eating for their health and future performance or using food for emotional support and rebelling against their usual strict practices (Bentley et al., 2021). Hedonistic eating is an emotional psychological barrier to quality nutrition often influenced by sport-specific motives, such as weight restrictions or those recovering from injury (Bentley et al., 2021; Birkenhead & Slater, 2015). Body composition and the perception of what the athlete's body should look like also influence dietary choices (Bentley et al., 2021). Focus groups with elite athletes found the physical monitoring of body composition was motivational for some athletes yet caused heightened emotional stress for others (Bentley et al., 2021). Measuring body composition could therefore have a positive or negative influence on athletes' adherence to dietary practices depending on the individual (Bentley et al., 2021). Feeling well prepared with nutrition knowledge to make decisions when eating out and planning meals is yet another influencing factor about athletes making the best choices for performance (Bentley et al., 2021; Garthe et al., 2013; Heaney et al., 2008). Although there is not a great deal of evidence for the weak relationship between nutrition knowledge and food choices in athletes, the athlete's drive for performance is likely to direct their food choices above all else (Birkenhead & Slater, 2015; Spronk et al., 2015). In a double armed NE intervention targeting weight gain in elite athletes, one group were given a diet plan and nutrition counselling, whilst the other were advised to gain weight by their own means without nutritional support (Garthe et al., 2013). Those in the group without a meal plan and nutrition counselling found it difficult to plan their meals, along with uncertainty around the amount and type of food they should consume to optimise lean mass gain (Garthe et al., 2013). NE that includes practical tips and opportunities for the athlete to put new learnings into practice may be a key strategy to overcoming these barriers and increase self-efficacy in food selection and planning. The importance of quality nutrition is not solely for days of high training loads and competition. Periods of rest, heavy and light loads of training, recovery, on and off seasons all require the athlete to adequately nourish their body. Taking the reality of the athlete's lifestyle into account to construct an effective NEP that addresses relevant barriers directly and could potentially improve the self-efficacy of athletes' nutrition knowledge and food choices (Coccia et al., 2020).

2.4 Nutrition knowledge

2.4.1 Nutrition knowledge and diet quality

Given the amount of stress athletes put their body under, and elite athletes having greater support resources available, the athlete's diet could be expected to be of a more nutritious quality than the

average healthy adult at baseline. Yet the athlete's diet, when compared to the general government dietary recommendations for healthy adults, is still falling short (Devlin & Belski, 2015; Spendlove et al., 2012; Spronk et al., 2015). Nutrition knowledge is often considered to be a main cause of the athlete's overall diet quality and behaviours (Heaney et al., 2008; Spronk et al., 2015). A positive relationship between nutrition knowledge and diet quality was found in a systematic review by Heaney et al., (2011). The positive relationship has again been observed in other studies in elite athletes (Heaney et al., 2008; Murphy & O'Reilly, 2021; Spronk et al., 2015). Though the idea that nutrition knowledge equates to good diet quality may be generally expected, Spronk et al. (2015) and Murphy and O'Reilly (2021) found this relationship to be only weak to moderate in elite athletes. This suggests that nutrition knowledge alone cannot be relied on for good diet quality in athletes. Systematic reviews have researched the outcomes of NEPs on the athlete's nutrition knowledge, and dietary intake (Tam et al., 2019; Boidin et al., 2020). However, both reviews were overall unable to draw conclusive summaries on effective NE strategies as the heterogeneity of interventions, made it difficult to directly compare interventions to understand effective and ineffective strategies.

Focus groups with sports coaches have shown a positive relationship between nutrition knowledge and diet quality (Heaney et al., 2008). Coaches expressed that the athlete's confidence in their ability (also known as self-efficacy (Kent, 2006)), to make appropriate dietary choices specific to their sport, was directly related to their knowledge in nutrition (Heaney et al., 2008). Both coaches and sports nutritionists agree that self-efficacy is important in the athlete's ability to improve their diet quality. While coaches do generally recognise nutrition knowledge in better dietary practices, sports nutritionists express concern regarding the conflicting roles within the athlete's support network offering contradictory nutrition guidance, consequently influencing the athlete's confidence in their nutrition knowledge (Bentley et al., 2019). This confusion in nutrition and athletes' misbeliefs around macronutrient distribution and importance of adequate carbohydrates may suggest that athletes are getting mixed messages in nutrition from various sources (Spendlove et al., 2012), and consequently not meeting the guidelines for this macronutrient (Condo et al., 2019; Jenner, Devlin, et al., 2019). This research emphasises that nutrition knowledge alone is not enough of an outcome in a NEP, and that other aspects of the athlete's barriers and enablers to dietary change need to be factored into a successful NEP.

2.4.2 Nutrition knowledge of athletes

A systematic review by Heaney et al. (2011) found the nutrition knowledge of athletes was similar to that of the general population, yet the evidence for this claim was weak. A few studies in the review

showed the nutrition knowledge in elite athletes was greater than that of the general adult population (Cupisti et al., 2002; Harrison et al., 1991). In more recent studies in Australian elite athletes, the athletes scored similarly or worse when compared to the general population (Devlin & Belski, 2015; Spendlove et al., 2012). Both these studies analysed the general nutrition knowledge of the athlete sample using the same validated questionnaire in similar age groups. Yet the work of Devlin and Belski (2015) was focused on male Australian rules football (AFL) athletes, compared to Spendlove et al. (2012) who included both genders across two sports: Australian life-saving, and junior elite rugby league players. The male AFL athletes scored lower than the athletes researched by Spendlove and colleagues in general nutrition knowledge. This finding could be related to overarching results in young males commonly scoring lower in nutrition knowledge than their female counterparts, seen most recently in a systematic review by Tam et al. (2021) with female athletes scoring significantly higher than males across both general and sports specific nutrition knowledge (Harrison et al., 1991; Heaney et al., 2011; Spendlove et al., 2012). However, female athletes do not necessarily have a good overall sports nutrition knowledge (Condo et al., 2019). Comparing studies assessing the nutrition knowledge in athlete groups should be done with caution, as a systematic review by Trakman et al. (2016) advise there is absence of a universally used tool for the assessment. However, Australian researchers are working towards new tools to validate athlete knowledge in sports nutrition (Capling et al., 2019; Tam et al., 2021; Trakman et al., 2017; Trakman et al., 2018).

Before modern network communications, sub-elite athletes were more likely at an educational disadvantage due to less funding and access to in person resources, compared to elite or professional athletes (Trakman et al., 2018). This is seen in work by Harrison et al. (1991), where New Zealand elite athletes were found to have greater nutrition knowledge than sub-elite athletes. In more recent nutrition knowledge investigations, sub-elite male Australian Football players scored better than the elite players in their sport (Trakman et al., 2018). Analogously, male elite athletes were found to score only slightly higher in nutrition knowledge than sub-elite Irish hurling players (Murphy & O'Reilly, 2021). The difference again comes with female athletes. Here, elite female Gaelic games players ($n=110$) scored significantly higher in overall nutrition knowledge and sports nutrition knowledge than sub-elite ($n=218$) players (Renard et al., 2020). Due to the different assessment tools used in studies, it is difficult to make an overall claim about the nutrition knowledge in athletes (Tam et al., 2019). However, it highlights that there is still much room for improvement in many areas of nutrition knowledge in athletes.

2.4.3 Sources of nutrition information for athletes

An unpredictable mix of popular opinions, personal beliefs, science and setting all influence where the athlete may seek their nutrition information. With the over saturation of nutrition advice accessible today, the athlete may be tempted to follow new fad diets to experience the performance benefits promised in marketing and social media campaigns (Heaney et al., 2008). In the instance of high performance colligate sport in the USA, many National Collegiate Athletic Association (NCAA) Division 1 programmes lack the staff and funding to provide individualised NE sessions to individual athletes. Of a sample ($n=597$) of athletes, coaches, strength and conditioning coaches, and athletic trainers from multiple NCAA athletic departments, athletes ($n=185$) were the only participant group to not actively seek nutrition information from a registered dietitian despite half of the athletes stating access to a registered dietitian was available to them (Torres-McGehee et al., 2012). In a validated questionnaire, Trakman et al. (2019) found friends and coaches to be a significantly more popular source for nutrition information in younger athletes, than athletes over the age of 35 years. One reason for athletes not seeking nutrition advice from a professional in the nutrition field is the athlete may not have a good awareness of evidence-based practice, compared to that of a coach or trainer, particularly a younger athlete. Professional athletes value evidence-based nutrition advice to improve performance and are likely to turn to practitioners within their sport for information, as found in professional Australian athletes ($n=32$) aged 18-41 years who participated in an online questionnaire focusing on the athlete's perceptions of evidence-based practice (Schwarz et al., 2021). On the other hand, programmes with less funding are likely to rely on coaches, and strength and conditioning coaches for NE with their athletes (Heaney et al., 2008; McCauley et al., 2021; Torres-McGehee et al., 2012; Zinn et al., 2006). This concern of athletes not having a credible source for their nutrition information can put the burden on the coaches to provide this information. Coaches have been known to have a focus on body weight and fat levels compared with sports dietitians, which may influence negative eating behaviours that are reportedly detrimental to the athlete's overall health and wellbeing (Beckner & Record, 2016; Bentley et al., 2021; Byrne & McLean, 2002; Heaney et al., 2008; Jenner et al., 2021; Shifflett et al., 2002).

Where athletes get their nutrition information from is likely to differ depending on the age and calibre of the athlete (Trakman et al., 2019). A questionnaire completed by 410 athletes from various Australian team sports showed the athlete's primary sources of nutrition information to be from family (58%), closely followed by friends, coach or trainer, and teammates (Trakman et al., 2019). Family, friends, and teammates were also found to be in the top five most reported sources of NE in female Gaelic games players, along with nutritionist and athletic trainer (Renard et al., 2020). The

most reported means for sourcing nutrition information in New Zealand elite athletes were the high performance nutritionist/dietitian, followed by the internet, friends/teammates, social media, and family (Bourke et al., 2019). Young Canadian athletes favoured receiving information regarding dietary supplements from friends and family over medical doctors and sports nutritionists (Wiens et al., 2014). The top three primary sources of nutrition information in elite male Australian athletes were found to be a dietitian, club trainer, and teammates (Devlin & Belski, 2015). The researchers here found no correlation when the athlete's sources of NE were analysed by age or years at elite level (Devlin & Belski, 2015). Athletes received their nutrition information from a range of professional and non-professional sources. While this may be where athletes currently receive their NE, this does not necessarily indicate where or who athletes prefer to receive their nutrition advice.

Social media can play an important role in promoting active information sharing and student engagement (Bikanga Ada et al., 2017). Furthermore, learning through social media may encourage self-efficacy in the learner, promoting motivation and autonomous learning (Dabbagh & Kitsantas, 2012). As a way for athletes to get their nutrition information, online platforms were not even featured in survey responses in the 1990s as a source of nutrition information among elite athletes (Hamilton et al., 1994; O'Halloran et al., 1990). The preference on the overall use of social media, the type of social media mobile applications and other technology-centric mediums are likely to vary depending on the age of the athletes (Bikanga Ada et al., 2017; Nascimento et al., 2016; Zuniga et al., 2017). A questionnaire administered in college athletes ($n=72$) found that the athletes said they were highly likely to use a mobile device application as a nutrition information platform (Zuniga et al., 2017). On a larger scale, a total of 306 New Zealand athletes (elite $n=87$, recreational $n=219$) participated in an online questionnaire quantifying the participant's use of social media in general as a source for nutrition information (Bourke et al., 2019). Social media was the most popular source of nutrition information, followed by internet and friends or teammates (Bourke et al., 2019). Despite this use of social media for gathering nutrition information, it has its shortfalls. The Healthy Women in Sport: A Performance Advantage (WHISPA) group from high performance sport New Zealand published findings from a survey in elite and development female athletes ($n=219$) where social media (59%; 51/87) was one of the three leading sources of pressure to conform to a cultural expectation of feminine appearance (along with themselves 80%, and their coach 53%) (Heather et al., 2021). With recent advances in the use of social media as an education medium, research is needed on the best way to utilise technology with athletes for NE delivery.

2.5 Need for quality nutrition education in athletes

2.5.1 Adherence to nutrition education in athletes

Long-term retention of nutrition knowledge following education is still largely unstudied in the athlete population (Tam et al., 2019). One NEP with Spanish professional handball league athletes followed up on the athlete's dietary practices two months following the intervention to find that they did maintain their dietary changes directly following the education programme (Molina-Lopez et al., 2013). There is a lack of research investigating the long-term knowledge retention following nutrition interventions, one study in female university athletes found knowledge retention three months following the NEP to be significantly improved from baseline nutrition knowledge, yet this was almost three decades ago (Collison., 1996). In contrast, other studies have shown that despite increased nutrition knowledge following a NEP, the knowledge is not applied to the athlete's food choices and athletes are inadequately utilising nutrition strategies which is leaving them unable to fully exploit on their performance goals (Martinelli, 2013; Spendlove et al., 2012). The two studies by Collison., (1996) and Molina-Lopez et al. (2013), despite their differences, do give us some insight that when an effective NEP is implemented, athletes are able to take on board their learnings and implement their new knowledge to improve their performance dietary practices.

Unlike the general population, motivation is not usually a barrier for the elite athlete, as performance is their ultimate goal and anything that will improve performance motivates change. However, behaviour change researchers question how stable this motivation is, particularly when food choices are closely linked to personal emotions and beliefs, and when the motivations of sporting performance are removed in the off-season (Bentley et al., 2021; Jenner et al., 2021; Stokes et al., 2018). Investigating athlete experiences of nutritional adherence to dietary change, Bentley et al. (2021) applies the Capability, Opportunity, and Motivation Behaviour (COM-B) model to athlete behaviour, describing that in order to adhere to dietary change, athletes need the capability, opportunity, and motivation to do so. These three elements will often overlap within each other. For example, athletes describe their ability to plan meals as a barrier to their nutrition intake, yet Bentley et al. (2021) affirm that the lack of opportunity to practice this skill and a lack of motivation to practice all contribute to the lack of adherence to adopting new behaviour. A NEP should motivate the athlete to undertake positive dietary practices, and ensure they are given enough support and resources to put knowledge into practice (Bentley et al., 2021). From this research it can be understood that simply equipping athletes with the knowledge and capability is not necessarily enough to provoke behaviour change.

Interventions need to be designed to bring about changes in dietary intake, as designing a NEP with the sole aim to improve nutrition knowledge will have less chances of positively influencing the athlete's dietary practices (Bentley et al., 2020). In a systematic review investigating behavioural strategies in sports nutrition interventions, the researchers found that interventions where improving athletes' dietary behaviours was consciously considered in the design of the NEP, that can prove successful in improving dietary intake (Bentley et al., 2020). Studies included in the review were those targeting dietary behaviour change, as opposed to studies objecting to solely improve knowledge and assess diet quality post intervention. Of the 16 studies meeting the systematic review's criteria, 13 showed significant changes in one or more dietary behaviours or dietary intake improvement. Overall no one behaviour change strategy was found to be unanimously beneficial across studies, though some strategies proved effective in some interventions yet ineffective in others (Bentley et al., 2020). The inability to narrow down beneficial strategies across NE interventions was also seen in systematic reviews by Tam et al. (2019) and Boidin et al. (2020) due to heterogeneity in study designs including athlete groups, dietary and nutrition knowledge assessment tools and interventions.

2.5.2 Learning style preferences

How an individual best learns is considered by researchers to be based on the person's own personal preference for a particular or multiple learning style (Dunn et al., 1995; Fuelscher et al., 2012; Leite et al., 2010). Popular models of learning style preferences have been developed and discussed in the literature regarding effective ways in which individuals can approach education to best digest and disseminate information (Cassidy, 2004). This includes the comprehensive model by Dunn (1990) which incorporates various elements under the student's environmental, emotional, sociological, physical, and psychological stimuli (Dunn et al., 1995). VARK, an acronym for visual, aural, read/write, and kinaesthetic, is a model preferences questionnaire developed by Neil Fleming for students and teachers to best understand preferred learning style(s) (Fleming, 2001; Fleming & Mills, 1992). Fleming explores the physical elements of Dunn and Dunn's learning styles model (Dunn et al., 1995). Visual preference is for learning through seeing elements such as flow charts, graphs, and icons. Reading and writing preferences, though still visual, are separated as a preference for seeing text or printed words. Individuals who prefer to learn through verbal discussion and heard information are considered aural learners. Whilst individuals who prefer to learn through 'either experience, example, practice or simulation' where many senses are used to interpret the information through a connection to reality or real-life examples (Fleming, 2001; Fleming & Mills, 1992). An additional category exists for those with multiple preferred learning styles, called multimodal (Fleming, 2001). It is emphasised by Fleming that these instructional preferences are independent of personal characteristics and does not focus

on the individual's social interaction or information processing techniques such as other models do (Fleming, 2001). Through understanding the preferred perceptual modes of learning, the teacher can tailor instruction, and the student is able to best understand how they learn new content. Though initially designed for the classroom setting, learning preferences have been applied to the athlete-coach setting with The VARK Questionnaire for Athletes (Dunn & Fleming, 2013; Fuelscher et al., 2012). Whilst this tool is often used during training or competition and less often in the classroom, characteristics specific to the athlete can be observed. For example, Fleming details that effective coaches will use both communication at the group level and the personal level to provide feedback to the athlete, acknowledging that each athlete has unique preferences for receiving information (Fleming et al., 2005).

It is important that education be presented in the athlete's preferred modality to avoid learning being a stressful time and to increase motivation (Dunn, 2009). Learning can become stressful when the athlete needs to adjust the education to their own learning style for easier comprehension (Dunn 2009). This is predominantly researched with the athlete-coach relationship, where technique and performance directions are communicated at times of performance pressure and fatigue. A coach who adapts to the preferred learning style of the athlete minimises chances for miscommunication during the transfer of knowledge (Fleming et al., 2005). Though in a more relaxed environment than the playing field, learning style preferences may be effectively applied to other areas of athlete learning such as NE.

2.5.3 Components of a NEP

NE interventions vary in four main characteristics throughout the research. These are the NE topics, the frequency and duration of the programme, the facilitator of the programme, and the instructional modality (Boidin et al., 2020). The work of Morgan and colleagues puts these down to four overarching components considered fundamental in a health behaviour intervention programme; content, format, facilitator, and pedagogy as seen in Figure 2.1 (Morgan et al., 2016). For this work in the nutrition field, the core principles of the conceptual model remain the same (Boidin et al., 2020; McCauley et al., 2021).

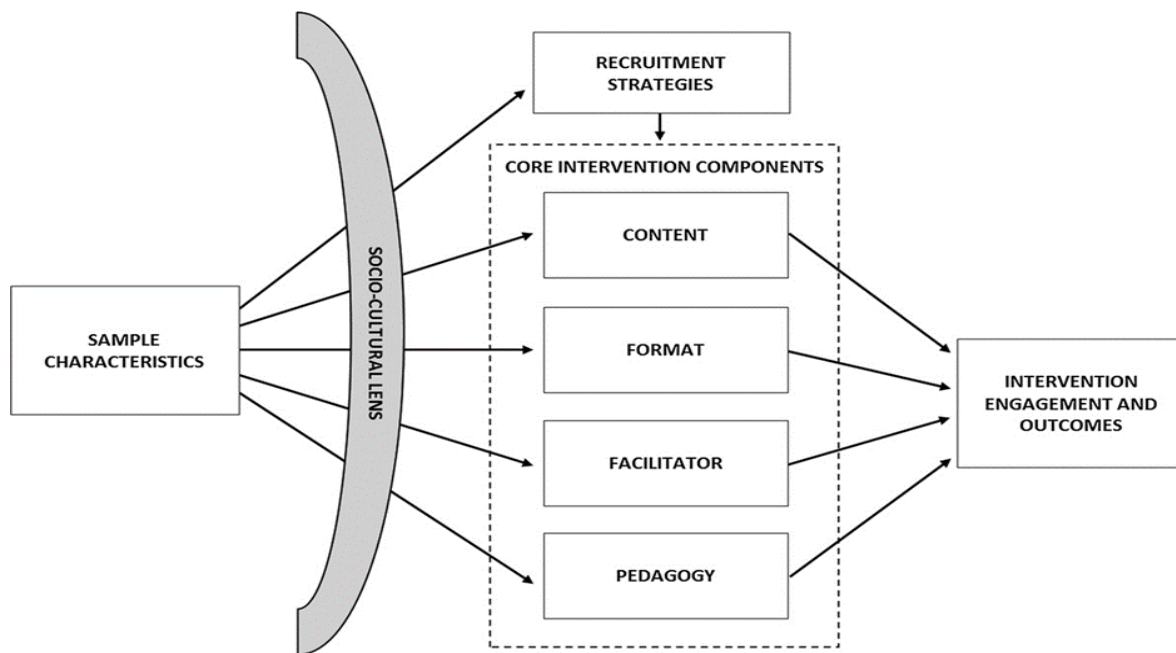


Figure 2.1 Conceptual model for a health behaviour intervention by Morgan et al. 2016.

The vast range of studies of varying education methods on different athlete groups across the world makes determining the most effective way of delivering NE challenging, as seen in recent systematic reviews (Boidin et al., 2020; Tam et al., 2019). In a systematic review of the impact of NE on athlete nutrition knowledge, significant improvements in athletes' nutrition knowledge were observed in 84% of the included studies (Tam et al., 2019). However, only 19% of the qualifying studies were in the elite athlete population, compared to the 56% of studies using college athletes in the USA (Tam et al., 2019). Almost half of the nutrition intervention studies focusing on behaviour change included in a systematic review by Bentley et al. (2020) were in collegiate athletes. Comparatively, in a systematic review studying the link between NE and dietary intake in athletes, less than 40% of the studies were in collegiate athletes, with most studies in national level athletes (Boidin et al., 2020). Whilst collegiate athletes may be at the elite level (Martinelli, 2013), collegiate athletes have a unique day to day experience balancing a scheduled training regime with academics, which should be considered in NEP research. With the limited amount of research in the effectiveness of NEPs in elite athletes, and considering the heterogeneity between sports, it is difficult to draw any conclusive statements regarding what elements of the various key components of a NEP are most effective.

2.6 Preferences and effectiveness of NEP components

2.6.1 Pedagogy

Pedagogy refers to the teaching methods used within an education programme and applied to facilitate learning. Pedagogical concepts for learning in elite athletes have been proposed in theories relating to the individual cognitive transfer of knowledge, socially constructed knowledge through participation, and learning through storytelling (Barker-Ruchti, 2019). The concept model by Morgan and colleagues (Figure 2.1) supports learning through teaching techniques of interactive communication and storytelling to apply new information (Morgan et al., 2016). This preference for understanding nutrition through personal experiences is seen in both elite and recreational athletes (Bourke et al., 2019). Teaching methods to consider with the athlete population should account for the competitive personality. This may include activities such as small group challenges, spot quizzes, and debates to enhance learning through meaningful and engaging conversations (Barker-Ruchti, 2019; Morgan et al., 2016).

Learning through participation focuses less on the cognitive achievement, and more on the social aspect of learning (Barker-Ruchti, 2019). The innate competitive nature of elite athletes may factor into their generally strong preferences for hands on and practical methods of learning (Barker-Ruchti, 2019; Braakhuis et al., 2015; Fleming et al., 2005; Parks et al., 2016). In a questionnaire from a sample of elite endurance athletes, the researchers found that athletes in the sample often took an experimental approach to nutrition, becoming curious with how different nutrition strategies affect their body and performance as opposed to strategies carefully planned from traditional nutrition guidelines (Heikura et al., 2017). This understanding of what athletes do with the information they are given is important when considering the delivery of NE. Data collected from the athlete learning style preferences quiz ($n=272$) exposed a dominance for the kinaesthetic learning style (28%) in New Zealand team sport athletes between 2003-2005 (Fleming et al., 2005). A leading preference among athletes for kinaesthetic learning (38%) was also found in the 2015 VARK athlete questionnaires in athletes from New Zealand and the United States of America ($n=93$) (Braakhuis et al., 2015). Braakhuis (2015) subsequently identified stronger preferences for multi-modality learning styles in the elite athlete participants, compared to the dominating kinaesthetic preferences in sub-elite athletes.

Storytelling is both a kinaesthetic and aural teaching technique for the transfer of knowledge and skills to the learner (Barker-Ruchti, 2019; Fleming et al., 2005; Morgan et al., 2016). Here the athlete may be encouraged to share and reflect on their journey of habits relating to their sports nutrition (Barker-Ruchti, 2019). This engaging teaching method gives athletes the opportunity to reflect on their

narrative as a performance athlete. Interventions including a sporting role model in the NEP to share their experiences may help to motivate and engage participants (Bourke et al., 2019; McCauley et al., 2021; Simpson et al., 2017; Stokes et al., 2018). Focus groups with New Zealand elite athletes share this value of multi-modality learning with favoured teaching techniques including visual content and storytelling (McCauley et al., 2021). Athletes appear to be less in favour of the use of writing tasks and large amounts of reading for gaining knowledge (Braakhuis et al., 2015; McCauley et al., 2021). Though Leite et al. (2010) concluded that while the VARK tool lacks validation as a reliable measure in research, the researchers acknowledge the tool's use as a preliminary test for both educators and athletes to identify their preferred way to process and perceive information holds value in practice.

The preferences of teaching techniques differ when analysed between female and male athletes (Beakey et al., 2020; Braakhuis et al., 2015; Fleming et al., 2005; Wiens et al., 2014). Survey results for concussion education preferences in adolescent male athletes showed a strong preference for interactive delivery styles, whilst the female athletes preferred written delivery modalities such as handouts and posters (Beakey et al., 2020). A significant relationship in the different learning preferences between male and female has also been found with the VARK questionnaire, with the majority of male athletes preferring kinaesthetic learning styles (e.g., learning through practice examples connected to reality (Fleming, 2001)), while the majority of females were multi-modal (Braakhuis et al., 2015). Female athletes had a significantly higher preference for the use of pamphlets, presentations, and individual consults for supplement education than the male athletes (Wiens et al., 2014). Furthermore, young adults (19-25 years) had a significantly stronger preference for obtaining information via online means compared to youth athletes (11-14 years) (Wiens et al., 2014). The age and gender of the athlete audience is worth considering when designing a NEP.

Learning through the transfer of knowledge includes both the direct transfer of knowledge from the facilitator to the learner, but it also includes how the learner takes this knowledge and applies it from situation to situation (Barker-Ruchti, 2019). In the context of NE, the first step is to increase nutrition knowledge and nutrition-related life-skills, and the second step is the improvement in the athlete's diet quality. Methods to monitor and set goals relating to the athlete's learning may include food journals as a tool for dietetic assessment and self-reflection of dietary intake. These could come in the form of a manually written journal, or as an application. The preference of food journals in general, and the idea of this tool as an application to improve nutrition knowledge and behaviours is increasing in popularity. One nutritional intervention study in elite male athletes found all participants either favoured the application method for recording their dietary intake, or stated no preference (Simpson

et al., 2017). Similarly, the use of an application for monitoring was favoured in New Zealand elite athletes (McCauley et al., 2021). Another method to increase motivation to improve nutritional practices is to have athletes involved in the creation of their own goals and outcomes from the NEP (Dunn, 2009; Garthe et al., 2013). It is important to note that in the goal setting preferences for athletes in regard to a NEP, the studies by Simpson et al. (2017) and Garthe et al. (2013) were 100% male athletes and 91% male athletes respectively. Given greater alleged societal pressures in female athletes for weight control, there may be reason to argue that logging meals and making them available to teammates and coaches could create self-perceived competition and increase eating anxieties for those already at risk, and that a more one-on-one style of goal setting could be preferred (Byrne & McLean, 2002; Heather et al., 2021; McCauley et al., 2021; Scott et al., 2021).

2.6.2 Format

The format of the NE applies to the setting, where or how it is delivered, and the duration, dose, and contact frequency of the programme (Morgan et al., 2016). All these elements need to be considered within the NEP for a successful transfer of knowledge for the athlete. Beyond the traditional face-to-face group lecture format, new modalities of teaching are beginning to be explored. Various methods for the transfer of knowledge include face-to-face delivery in large or small group sessions, individual counselling, interactive group workshops or activities, technology-based deliveries, and mixed method modalities for example lecture plus a handout, or lectures plus an individual consultation (Boidin et al., 2020; Tam et al., 2019). Learning tool preferences in non-athlete college students and educators found Facebook to be the most used social media platform among students, whilst YouTube was the most used with educators (Bikanga Ada et al., 2017). In athletes, the idea of online applications to receive nutrition information is popular (Coccia et al., 2020; Renard et al., 2020; Simpson et al., 2017; Trakman et al., 2019). Embracing a platform that the athlete is already using was found to be important in a nutrition education intervention by Coccia et al., (2020). Though the researchers found an increase in nutrition knowledge in college athletes after a six-week intervention using Twitter, the athletes did not usually use Twitter as a platform and this was a barrier for the athletes who needed to remind themselves to login (Coccia et al., 2020). A mixture of the previously mentioned delivery and format methods has been explored in the elite athlete population, yet again, the variations between the studies makes it difficult to compare the most effective methods (Boidin et al., 2020; Tam et al., 2019). Understanding athletes' perspectives on the temporal, demographical, and numerical variables of how their education is taught will be key in the development of future NEPs and research interventions (McCauley et al., 2021).

Observed in systematic reviews by Boidin et al. (2020) and (Tam et al., 2019), the setting, frequency and dose of the NEP have vast differences across studied interventions. In a study exploring athlete preferences for concussion education through an online survey, over half of the participants in the sample of NCAA collegiate athletes preferred a lecture or a video for their concussion education (Kroshus & Baugh, 2016). Less popular delivery methods in these college athletes were webinars, online materials, and emails, noting that in this survey there was no option for one-on-one consultations, only 'informal conversations' and an 'other' section (Kroshus & Baugh, 2016). The most preferred setting for supplement education in young Canadian athletes ($n=567$), were one-on-one consultations (69%), followed by lecture style presentations (63%) (Wiens et al., 2014). Qualitative discussions in focus groups with athletes show a leading preference for one-on-one consultations for the individual, and tailored benefits that come with meeting an athlete's nutritional needs (Jenner et al., 2021; McCauley et al., 2021). This is also seen in a sample of female Gaelic games athletes ($n=328$), 29% of athletes preferring nutrition support from private consultations with a dietitian or nutritionist compared to group presentations (5.8%) and cooking classes (3%) (Renard et al., 2020). Athletes do however acknowledge the place in a NEP for group style lectures to cover the more basic principles of performance nutrition (Jenner et al., 2021; McCauley et al., 2021). This dominant preference in the literature for one-on-one sessions (when offered) followed by lectures, shows the value athletes put on in-person interaction that comes with these delivery formats as opposed to online delivery methods.

2.6.3 Content

Content is an overarching term for all the recommendations, information, and messages used within the programme to target behaviour change (Morgan et al., 2016). This can be broken up into three important aspects relating to content; curricular topics, content characteristics, and nutrition-related life-skills (McCauley et al., 2021). The Thomas et al. (2016) nutrition and athletic performance position statement outlined that a sports NE should aim to improve the energy intake, body composition, and performance-related nutrition with the goal of leaving the athlete adequately prepared for performance. Along with these key curriculum topics, other topics of importance include pre, during and post-event eating, hydration, carbohydrate intake guidelines, protein intake guidelines, dietary supplements, and topics for specific population groups including vegetarians, and athletes training and competing in extreme environments (Thomas et al., 2016). In the framework for the development of a NEP by Parks et al. (2016), the curriculum is sectioned to four domains: basic nutrition concepts, basic food skills, performance nutrition, and performance enhancement.

The NEP curriculum should be designed with input from the nutrition professional, support staff, and the athlete themselves (Parks et al., 2016). In elite athletes the prominent curriculum topics in studied nutrition interventions appear to be hydration, body composition, dietary supplements, and nutrition periodisation (e.g., pre and post training nutrition) (Elias et al., 2018; Martinelli, 2013; Simpson et al., 2017; Tam et al., 2019). Athletes' most preferred topics to be included in the NEP include supplements and nutrition periodisation, but athletes also expressed the desire for more education surrounding diet trends, and the amounts of foods needed from the various food groups (Bourke et al., 2019; McCauley et al., 2021; Simpson et al., 2017). Discussing popular diet trends in the NEP is of importance to avoid athletes crash dieting and attempting harmful and unsustainable dietary behaviours (Parks et al., 2016). There is a common rhetoric in sports for NE to drive body composition. Barriers centric to body image illustrate the need for a shift for NE to support the athlete's overall performance, rather than narrowing down to one aspect of the bigger picture of performance (Bentley et al., 2021). Yet, body composition and weight management should remain an important curricular item for this group (Blauwet et al., 2017; Scaramella et al., 2018). Following semi-structured interviews with professional AFL around how body composition targets influence their dietary intake, the researchers advise that the players are likely to benefit from individualised advice focusing on realistic goals tailored for the individual athlete (Jenner et al., 2021).

Interventions involving nutrition-related life-skills include common daily tasks such as meal planning, label reading and grocery shopping (Wong et al., 2018). Including practical skills such as grocery shopping for both the athlete and non-athlete groups are under-represented in the literature, however athletes may find these interventions the most useful as many find it difficult to apply their knowledge (McCauley et al., 2021; Nikolaus et al., 2016; Tam et al., 2019). Elite Australian, and USA collegiate athletes are in favour of skills-based learning such as cooking classes being incorporated into their NEP (Ellis et al., 2018; Trakman et al., 2019). Recipes was the top topic that New Zealand athletes expressed seeking nutrition information for in social media, suggesting a need for the inclusion of cooking skills and meal suggestions in a NEP (Bourke et al., 2019). Despite these findings, when ranked against private consultations and healthy eating advice, cooking classes were only ranked the most useful type of nutrition intervention by 3% of female Gaelic games players (Renard et al., 2020). Including nutrition-related life-skills into the NEP should not be ruled out, as it provides the opportunity for athletes to practice and develop proficiency and confidence within sport nutrition (Bentley et al., 2019). In a systematic review by Nikolaus and colleagues, half of the qualifying studies had an increase in participant knowledge following the supermarket tours, and all of the studies that assessed behaviour change found that participants had adopted at least one positive change towards

their health following intervention (Nikolaus et al., 2016). In adolescent athletes, the use of supermarket tours has improved nutrition knowledge and the understanding of food labels and nutrient sources (Philippou et al., 2017). This positive impact is again seen in adolescent athletes involved in the WAVE programme, a combination of lectures and life-skill activities (Wong et al., 2018). Adolescent athletes who participated in the WAVE programme as part of a two-year experimental double arm study, showed an improved knowledge in sports nutrition, motivation to eat to maximise sporting performance, and increased their overall awareness of the importance of nutrition (Patton-Lopez et al., 2018). There is still not enough evidence to demonstrate how effective these examples of life-skill learning activities may be, but the acceptability and positive behavioural outcomes seen in these studies should be further pursued, given that this is something athletes want in their NEP (McCauley et al., 2021).

2.6.4 Facilitator

The leader of learning is an expert who facilitates the transfer of knowledge to the learner (Barker-Ruchti, 2019). How coaches and sports nutritionists work together to best deliver information to the athlete is important when there can be so many professionals involved in the athlete's care (Dijkstra et al., 2014). The athlete's relationship with the sports nutritionist can be a strong enabler for healthy dietary practices (Bentley et al., 2021), yet coaches are often relied on as the athlete's primary source of NE (Trakman et al., 2016). Having the coach so involved in something as personal as diet may create unease in athletes, considering the coach's authority with selection and concern with the athlete's body composition (Heaney et al., 2008; Heather et al., 2021; Stewart et al., 2017). The important transfer of knowledge is usually done through the demonstration and instruction of an expert in the field (Barker-Ruchti, 2019). An expert in performance nutrition is a qualified individual with the role and responsibility to assess the nutrition needs of the athlete, interpret biochemical and anthropometric information, collaborate with other professionals, accurately evaluate the literature, and educate the athlete appropriately, all with professionalism (Thomas et al., 2016).

Who athletes prefer to deliver their NE may depend on their age and gender. A survey enquiring into the preferences for concussion education in 2444 adolescent amateur athletes participating in contact ball sports such as rugby union, soccer and Gaelic football indicated strong preferences for professional players or coaches as facilitators in the male participants, whilst the majority of female participants preferred a medical professional to deliver their education (Beakey et al., 2020). In questionnaires completed by South African rugby players ($n=3921$), junior players ($n=2279$, average age 17 years) had a significantly greater preference for the coach as their preferred source of

education for warm-up and cool-down injury prevention information compared to senior players ($n=1642$, average age 25 years) who identified a physiotherapist as their preferred facilitator for this information (Brown et al., 2018). In an online survey in 325 NCAA collegiate athletes, 83% of participants preferred an athletic trainer to facilitate their concussion education, followed by a 55% and 41% preference for physicians and coaches respectively (Kroshus & Baugh, 2016). Despite the focus on injury awareness and prevention, with the sample focus being on adolescent and collegiate athletes (less than 29 years), the research suggests that younger athletes prefer the education to come from someone with whom they already have a well-established relationship such as their coach, athletic trainer, or physiotherapist.

Despite athletes currently getting their nutrition information from predominantly friends and family, this does not appear to align with recent research on athlete preferences (Trakman et al., 2019). In Australian team athletes, a dietitian was the most popular first choice for nutrition information (Trakman et al., 2019). Female Gaelic games players also preferred to receive their nutrition information from a nutritionist, followed by a dietitian as their third most preferred source for information (Renard et al., 2020). The preference for sessions to be exclusively led by a professional nutritionist or dietitian is not consistent across all studies, though it may be the preferred resource for coaches and trainers. Athletes may feel more comfortable in receiving NE from someone who they have a relationship with, and who will be an ongoing part of their professional team (Rastmanesh et al., 2007; Stewart et al., 2017; Torres-McGehee et al., 2012). The nutrition knowledge of coaches is generally seen to be greater than that of athletes, however different knowledge validation tools in studies makes it difficult to draw direct conclusions (Torres-McGehee et al., 2012; Trakman et al., 2016). One intervention of interest found an 82% increase in the number of participants who claimed a benefit from having input from a sports dietitian for individualised nutrition advice (Simpson et al., 2017). More input and exposure to dietitians as part of the athlete's support network may offer increased appreciation for the place of a dietitian in the sporting team. This is worth exploring further as having a sports dietitian as a full-time member of the team does appear to improve nutrition behaviours in athletes (Hull et al., 2017).

The personality traits of the facilitator are desired to be someone who is likable, relatable, and credible (Morgan et al., 2016). New Zealand elite athletes agree that the facilitator should be someone who is non-judgmental, knowledgeable, and approachable (McCauley et al., 2021). Morgan et al. (2016) also details that the education programme, should be both engaging and enjoyable. For effective NE, first year college student athletes stated a preference for an engaging facilitator as part of the programme

(Kicklighter et al., 2010). The physical appearance of the facilitator in sports is one that has in the past been found to influence how much confidence the athlete has in a facilitator's ability. Facilitators with a fit, healthy appearance were found to appear more effective at their job than those of the same qualification who do not fall into the normal BMI range (Hutson, 2013; Lovell et al., 2013). Similarly, the facilitator dressed in sports attire was perceived more favourably by athletes than when dressed in formal business dress (Lovell et al., 2013). However, in a recent online survey with fitness facility users ($n=455$), for participants to have trust and have confidence in nutrition advice from exercise professionals, it was more important the professional had academic qualifications and held themselves with professional conduct than their physical attractiveness and fitness physique (Mitchell et al., 2021). New Zealand elite athletes agreed that the qualification, and the facilitator's interest in their sport was of far more importance than their physical appearance when it came to NE (McCauley et al., 2021).

2.7 Summary

For the athlete, NE has the potential to become a catalyst for the athlete to optimise their diet and consequently enhance their performance quality. There are a number of interventions studying NE and knowledge in athletes, but the athlete's preferences for the design and delivery of the education is not a focus. Furthermore, despite the influence of nutrition on performance being widely known, the evidence in athletes' dietary intake indicates athletes are not consistently meeting important macro and micronutrients requirements vital for performance, recovery, and overall health and wellbeing. This lack of adherence to nutrition guidelines can be due to common barriers the athlete faces, including some that are unique to the lived experiences and social influences of the athlete. Quantifying athletes' preferences for a NEP may prove to be an important step for facilitating behavioural change and breaking down athlete specific barriers to change. In the design of an effective NEP, athlete preferences may be used to support the COM-B model and improve the outcome of behavioural change and dietary practices (Bentley et al., 2019; Morgan et al., 2016). There have been a few studies exploring athlete preferences for a NEP in focus groups, yet these preferences are yet to be quantified. A well-designed NEP that fits the athlete group can be utilised by sporting organisations and institutions, dietitians and nutrition professionals, and future research projects requiring NE interventions to benefit athletes and their performance with immediate and long-term impact.

3 Chapter Three: Research Study Manuscript

3.1 Abstract

Background: Nutrition education (NE) has the potential to be a catalyst for athletes to optimise their diet and consequently enhance performance. However, very little research has been undertaken to understand what athletes would like in a nutrition education programme (NEP). The present study aimed to investigate the preferences of elite athletes for a NEP with a specific focus on preferences for pedagogy, content, format, and facilitator.

Methods: Athletes ($n=124$, median (IQR)=22 (9) years, female 54.8%) competing at a national or international level from 22 sports, and living in New Zealand ($n=101$, 81.5%) and Australia ($n=19$, 15.3%) participated in an online survey developed by the researchers. Responses (from descriptive Likert scales, ranking of preferences, single and multiple answer multi-choice questions) were analysed using descriptive statistics.

Results: Athletes were *very* (45.2%) or *extremely interested* (37.9%) in NE and value a NEP that is engaging (96.0%) and credible (91.1%). Teaching techniques considered *extremely effective* for learning were life examples (47.6%), applied hands on activities (30.6%), and discussions with the facilitator (30.6%). Setting personal nutrition goals was important to most athletes (83.9%), along with two-way feedback with the facilitator (75.0%). General nutrition topics considered an *essential* priority for NE were energy requirements (52.4% of athletes), hydration (52.4%), and nutrient deficiencies (41.9%). Performance topics considered *essential* were recovery (58.1%), pre-exercise nutrition (51.6%), nutrition during exercise (50.0%) and energy requirements for training (49.2%). Adapting meals for training requirements (37.9% of athletes) and behaviour change techniques (26.6%) were considered *essential* nutrition-related life-skills. Credible content was important (91.1%), and most participants wanted some repetition of topics (69.4%). Athletes' top-ranked setting preferences were 'in person group sessions' (mean rank 4.66), followed by a 'mixture of in person one-on-one and group sessions' (mean rank 4.55), and 'one-on-one sessions' (mean rank 4.48). For both online and in person group sessions most athletes wanted to share NE with athletes of the same sporting calibre (61.3%) and with 6-10 others (in person 44.4%, online 31.5%). Preferred session duration was 31-60 minutes (in person 63.7%, online 58.9%) and held monthly (in person 36.3%, online 38.7%). A performance dietitian or nutritionist was the top-ranked facilitator (mean rank 4.09), followed by a sports/exercise physiologist (mean rank 4.07), and an experienced athlete in the sport (mean rank 3.69). Preferred facilitator traits were credibility (73.4%), experience in sports nutrition (76.6%) and knowledge of the sport (85.5%).

Conclusions: Athletes were interested in NE and valued an engaging NEP that included kinaesthetic, aural, and visual teaching techniques. Athletes preferred 'in person group sessions' for the delivery of

NE. Preferences were that content be credible, and covered a mixture of general, performance and skills-based nutrition topics, such as adapting meals for sporting requirements. Credibility of the facilitator was important, as was experience in sports nutrition and knowledge of the athlete's sport. Further research is needed with athletes at different levels and across all sports to further understand athletes' preferences for NE.

3.2 Introduction

High quality nutrition and optimal dietary intake are important for an athlete's performance and maintenance of overall health status (Mountjoy et al., 2014; Thomas et al., 2016). Through optimising nutrition, the athlete's physical performance, cognitive function, immunity, recovery from training, and injury management all benefit (Burke & Deakin, 2015; Smith-Ryan et al., 2020).

Several factors impact an athlete's ability to achieve optimal nutrition. These include convenience, income, cost, taste preferences, body image, culture, lifestyle, health beliefs, weight control, and gastrointestinal discomfort (Birkenhead & Slater, 2015; Garthe et al., 2013; Heaney et al., 2008; Rossi et al., 2017; Thurecht & Pelly, 2020). In addition, nutrition knowledge may influence the quality of an athlete's dietary intake (Heaney et al., 2011; Spronk et al., 2015). Previous studies in elite athletes, including systematic reviews by Heaney et al. (2011), Tam et al. (2019) and Boidin et al. (2020), have reported several gaps in athletes' understanding and knowledge regarding dietary intake and practices, that when addressed could aid their health and performance (Bolling et al., 2020; Burke et al., 2003; Burke et al., 2001; Devlin & Belski, 2015; Spendlove et al., 2012).

Nutrition knowledge can be improved through nutrition education. In a systematic review, Tam et al. (2019) found over 80% of NE interventions resulted in improved nutrition knowledge in athletes. Yet, another systematic review found the effectiveness of various nutrition education programmes (NEP) was much less significant in improving dietary intake, displaying the difficulty of executing an effective NEP to influence and improve the quality of an athlete's diet (Boidin et al., 2020). Furthermore, the vastness of methods used in NE interventions makes conclusions regarding the most effective NEP difficult to draw.

There is a lack of evidence quantifying what can be done in NEPs to support athletes in improving their knowledge, but also what is needed for athletes to make the necessary behavioural changes to improve diet quality. Whilst NE preferences have been explored in non-athlete groups (Ashton et al., 2017; Cruickshank et al., 2018), research has only recently started to explore elite athlete preferences

for NE (Jenner et al., 2021; McCauley et al., 2021). Qualitative research within high performance New Zealand athletes found a preference for NE that lasted six months and began in the off-season with approximately 10 athletes per class (McCauley et al., 2021). Further research needs to be undertaken to quantify athlete preferences for NE pedagogy, format, content, and facilitator, taking into consideration the daily responsibilities and common barriers to behavioural change seen in the athlete population (Bentley et al., 2020; Bentley et al., 2021; Birkenhead & Slater, 2015; Jenner et al., 2021; Thurecht & Pelly, 2020). Such insight could be utilised by health practitioners, sporting institutions and organisations, and future researchers wishing to implement effective NEP's (Zoellner & Harris, 2017).

This research therefore aims to develop and implement a survey to obtain a comprehensive understanding of athlete preferences for a NEP.

3.3 Methods

3.3.1 Study design and participants

To gain objective truths about how NE may best be implemented with elite athletes, previous quantitative findings were utilised to develop a survey for quantitative analysis, with the aim of reaching a logical conclusion from a larger sample size (Almalki, 2016; Zoellner & Harris, 2017). The present study design is a descriptive cross-sectional analysis. Recruited participants were elite athletes described as those actively competing in Australia or New Zealand at a national and international level. All participants were over 16 years of age and completed an online consent form prior to completing the survey. Ethics approval for the research was granted through the Massey University Human Ethics Committee (MUHEC) Northern (reference NOR 21/38) with Reciprocal Approval from the Australian Institute of Sport (AIS) Ethic Committee.

3.3.2 Development of athlete nutrition education preferences survey

A team of five New Zealand and Australian based researchers developed, pretested, and piloted a targeted athlete-specific survey (see Appendix A). The research team included three accredited/registered dietitians, a sports physiologist, and second year Master of Science nutrition and dietetics student. The survey questions were based on the findings from focus groups exploring preferences for NE in 20 elite athletes (McCauley et al., 2021). A conceptual model by Morgan et al. (2016) suggests content, format, facilitator, and pedagogy as important components for healthy behaviour changes in a NEP. Survey development was undertaken using online survey development guides (Blair et al., 2014; Couper, 2008), and results from previous studies on athlete education preferences in NE and other topics such as concussion (Ashton et al., 2017; Beakey et al., 2020; Bourke

et al., 2019; Braakhuis, 2015; Jenner et al., 2021; Kroshus & Baugh, 2016; McCauley et al., 2021; Wiens et al., 2014). Justification and relevant references for content and construct of the included questions is detailed in Appendix B.

Multiple rounds of pretesting were undertaken with 15 peers in the athletic and academic community (ex-elite athletes $n=10$, Massey University nutrition staff/students $n=3$, other $n=1$) to detect any flaws and ensure readability (Blair et al., 2014). The survey went through over 25 draft edits and reviews. Major refinements included the following: using lay terminology, avoidance of repetition, ensuring all questions were directly relevant to the research objectives, and avoiding bipolar agree/disagree scales in favour of unipolar scales which can be answered more directly and easily by the participant/s, yielding higher quality data (Blair et al., 2014; Höhne & Lenzner, 2018; Saris et al., 2010). Specific details on the phrasing logic and preferences explored in each question of the survey are outlined in Appendix B.

Following pretesting and adaptation, an invitation for pilot testing was sent out via email invitation to 20 New Zealand elite athletes across nine different sports (Massey University Human Ethics Committee: Southern B, Application SOB 20/02). The completed responses ($n=11$; 7 females) were athletes from badminton ($n=4$), athletics ($n=2$), motorsport ($n=2$), water polo, swimming, and soccer (all $n=1$). Pilot testing permitted further insight to the usability and understanding of the survey. Changes made following the pilot testing included different phrasing of questions to reflect more direct Likert anchors (e.g., 1 - *not a priority* through to 5 - *essential* priority) and consolidation of questions/topics in the teaching preferences section, ensuring all were relevant and different. Changes to reduce the length included: reducing the thought processes for questions by asking athletes to “check all that apply” rather than a scale, deleting questions that did not directly relate to the study objectives, and asking participants to rank only the top three statements in ranked order questions. Athletes involved in pretesting and pilot testing did not participate in the final survey.

The final survey consisted of six parts: questions on previous NE, preferences for content, format, facilitator, pedagogy, and a sport/demographic section. The survey consisted of closed questions however one open answer question was included asking the participant to describe their ideal NEP. To understand the participant’s preferences for the content, participants were asked how much they prioritised curricular topics related to general, performance, and skills related nutrition information as outlined in the model by Parks et al. (2016). This was followed by asking athletes’ preferences for various characteristics of the **content** including repetition of topics, the importance of credibility and

the inclusion of skills-based sessions. The **format** section was divided into three parts: general delivery, in person, and online delivery sessions. The **facilitator** section comprised of five questions aimed at quantifying the athlete's preferences for personal attributes, qualifications, and experience in a facilitator. The section on **pedagogy**, consisted of three matrix tables to understand the participant's preference of teaching techniques, along with how much they valued the use of various feedback and monitoring strategies. The final survey can be found in Appendix A and justification for inclusion of questions in Appendix B.

3.3.3 Data collection

Recruitment was undertaken using convenience sampling in New Zealand and Australia. Data was collected via an online survey (Qualtrics 2021, version June 2021). The survey was shared through existing industry contacts and advertising on social media channels (Facebook, Instagram, LinkedIn). Additionally, practitioners across the National Institute Network (NIN) in Australia were informed of the research and interested practitioners then forwarded the survey to athletes within their network. All potential participants were invited to complete the survey in their own time from early September through to late November 2021.

The survey commenced with the information sheet (see Appendix C), and participants completed a brief screening questionnaire to ensure eligibility. Following the attainment of consent and meeting the study inclusion criteria, the full survey was made available to the participant. This initially took 15-20 minutes. A review of the response rate after one week resulted in edits being made to shorten the survey to an approximate 10-15 minutes in duration, see Appendix D for edits made. Emails were sent to practitioners advising them of the shorter completion time and encouraging practitioners to advise athletes in their network of the change, re-inviting them to participate (Couper, 2008).

3.3.4 Statistical methods for data analysis

Data was entered, checked for authenticity, and analysed using IBM SPSS Statistics (version 27.0). Descriptive statistics (i.e., frequency counts, percentages, median (IQR)) were calculated for all variables, and mean ranks calculated for rank order questions. Text answers to "other" were categorised appropriately to match existing options or independently coded as "other" and footnoted. Answers to the single open-ended question were analysed to find focal themes.

3.4 Results

3.4.1 Participant characteristics

A total of 138 completed responses were received on the online survey. Of the 138 responses, 10.1% were <16 years of age ($n=2$), not competing at the national or international level ($n=11$), or did not provide consent ($n=1$). The screening questions prevented these participants from progressing to the main body of the survey. This left a total of 124 responses for analysis (females 54.8%) all of which were completed to a satisfactory level where all four sections relating to NEP content, format, facilitator, pedagogy preferences were answered.

Of the final responses, 101 athletes were living in New Zealand (81.5%), 19 in Australia (15.3%), and 4 elsewhere (3.2%). The majority (55.6%) had completed or were currently working towards a university qualification, of this 8.9% indicated completing university level papers related to nutrition science. The largest category of athletes (38.7%) were living with their parents or family. Preparation and cooking were predominately shared responsibility (43.5%) or managed by the individual (37.9%). Food purchasing was largely managed by the athlete (41.1%).

*Table 3.1 Participant Characteristics (n=124)**

Variable	Participants, n (%)
Age*	22.0 (9) †
Gender*	
Female	68 (54.8)
Male	50 (40.3)
Highest education level*‡	
School ≤ year 11	5 (3.2)
School year 12 or 13	40 (32.3)
Polytechnic or apprenticeship	4 (4.0)
University	69 (55.6)
Nutrition Science §	11 (8.9)
Current living situation*	
With family	48 (38.7)
Boarding school/hostel	4 (3.2)
With housemates	29 (23.4)
Alone	6 (4.8)
With partner/spouse	31 (25.0)

Food purchasing
responsibility*

Self	51 (41.1)
Another household member	29 (23.4)
Shared responsibility	34 (27.4)
Food service organisation	4 (3.2)

Food preparation/cooking
responsibility *

Self	47 (37.9)
Another household member	14 (11.3)
Shared responsibility	54 (43.5)
Food service organisation	3 (2.4)

Special dietary
requirements*

Yes [¶]	24 (19.4)
No	94 (75.8)

* Missing information n=6 (4.8%).

† Median (IQR).

‡ School years are described as per the New Zealand Qualifications Authority (NZQA).

§ Positive responders engaging in nutrition studies included: sports and exercise science (n=4), nutrition (n=4), exercise physiology (n=2), missing (n=1).

^{||} Includes athlete who specified also needing to purchase their own food for training.

[¶] Count of responses included: dairy free (including lactose sensitivity and intolerance) (n=8), gluten free (includes wheat free and gluten intolerance) (n=5), vegetarian (includes pollotarian, pesco-pollo vegetarian) (n=5), diabetes (n=3), coeliac disease (n=2), low iron (n=2), nut allergy (n=2), other food allergies, environmentally conscious, no fowl meat (all n=1).

3.4.1.1 Sport representation

The largest sporting groups represented were rowing (26.6%), athletics (8.9%), and cycling (8.9%). Contact team sports included rugby (5.6%), hockey (2.4%), basketball (1.6%), and inline hockey (0.8%). Most athletes were competing at a national level (35.5%), followed by international open (29.8%), and international age group (28.2%). Athletes had mostly competed in high performance sport for 1-3 (33.1%) or 3-5 years (29.8%).

Table 3.2 Sport Representation (n=124)*

Variable	Participants, n (%)
Sport*	
Rowing [†]	33 (26.6)
Athletics [‡]	11 (8.9)

Variable	Participants, <i>n</i> (%)
Cycling§	11 (8.9)
Triathlon	9 (7.3)
Kayaking/canoeing	8 (6.5)
Skating	8 (6.5)
Rugby	7 (5.6)
Auto racing	6 (4.8)
Swimming	6 (4.8)
Sailing	4 (3.2)
Hockey	3 (2.4)
Table tennis	3 (2.4)
Basketball	2 (1.6)
Para-Equestrian	2 (1.6)
Other¶	3 (2.4)
Highest level of participation*	
National	44 (35.5)
International - age group	35 (28.2)
International - open	37 (29.8)
Years in high performance sport*	
1 to 3	41 (33.1)
3 to 5	37 (29.8)
5 to 10	24 (19.4)
10 plus	14 (11.3)

* Missing information (*n*=8, 6.5%).

† Heavy weight (*n*=27), light weight, coxswain (both *n*=3).

‡ Athletics includes: running (*n*=5), track (*n*=4), jumping, sprinting (all *n*=1).

§ Track, road (both *n*=4), mountain bike (*n*=2), unknown (*n*=1).

|| Skating includes: artistic roller skating (*n*=3), figure skating (*n*=4), inline hockey (*n*=1).

¶ Para-cycling, surf lifesaving, tennis (all *n*=1).

3.4.1.2 Nutrition education characteristics

Most athletes (72.1%) were *very* or *extremely interested* in performance nutrition. Common sources for NE were coaches (62.2%), other athletes (60.1%), specialist sports dietitians or performance nutritionists (56.6%), and social media platforms (55.2%).

Table 3.3 Nutrition Education (NE) Related Characteristics (n=124)

Variable		Participants, n (%)
General interest		
	Extremely interested	47 (37.9)
	Very interested	56 (45.2)
	Moderately interested	18 (14.5)
	Slightly interested	3 (2.4)
	Not at all interested	0 (0.0)
NE sources*		
	Person	
	Coach	89 (71.8)
	Teammates/other athletes	86 (69.4)
	Sports dietitian/nutritionist	81 (65.3)
	Fitness/strength trainer	75 (60.5)
	Parents/family members	69 (55.6)
	Sport/exercise physiologist	60 (48.4)
	General dietitian/nutritionist	53 (42.7)
	Doctor/nurse	38 (30.6)
	Physical therapist	23 (18.5)
	Gym staff	21 (16.9)
	Manager	13 (10.5)
	Chef	12 (9.7)
	Complimentary therapies†	10 (8.1)
	Organisations	
	Sporting organisations	58 (46.8)
	Secondary school curriculum	54 (43.5)
	University education	33 (26.6)
	Non-online	
	Mainstream media	55 (44.4)
	Academic journals/textbooks	48 (38.7)
	Magazine/books	36 (29.0)

Variable	Participants, <i>n</i> (%)
Online	
Social media platforms	79 (63.7)
Internet media	71 (57.3)
Podcasts	35 (28.2)

NE =Nutrition Education. *Multiple responses allowed.

†Complimentary therapies may include therapies such as acupuncture, naturopathy, reiki, and other such therapies.

3.4.2 Pedagogy

3.4.2.1 Engagement and enjoyment

There was an overall agreement that a NEP should be engaging *always* (45.2%), or *often* (50.8%), with remaining responses indicating *sometimes* (4.0%). Athletes specified a NEP should be enjoyable *always* (27.4%), *often* (54.0%), *sometimes* (17.7%), and *rarely* (0.8%).

3.4.2.2 Teaching techniques

Preferred teaching techniques were a mixture of kinaesthetic (e.g., life examples, use of interesting examples and stories, demonstrations and applied ‘hands-on’ activities), aural (e.g., open discussions with the facilitator and others), and visual techniques (e.g., visual content such as charts, diagrams, and infographics, and being shown the big picture or overall message first). Teaching techniques related to a reading, writing, or recording (e.g., self-monitoring with mobile applications, reference to research articles, reflective journals, and workbooks) were less preferred. Teaching techniques involving competition (e.g., small group challenges, competitions/games, and debates) showed a mixed response.

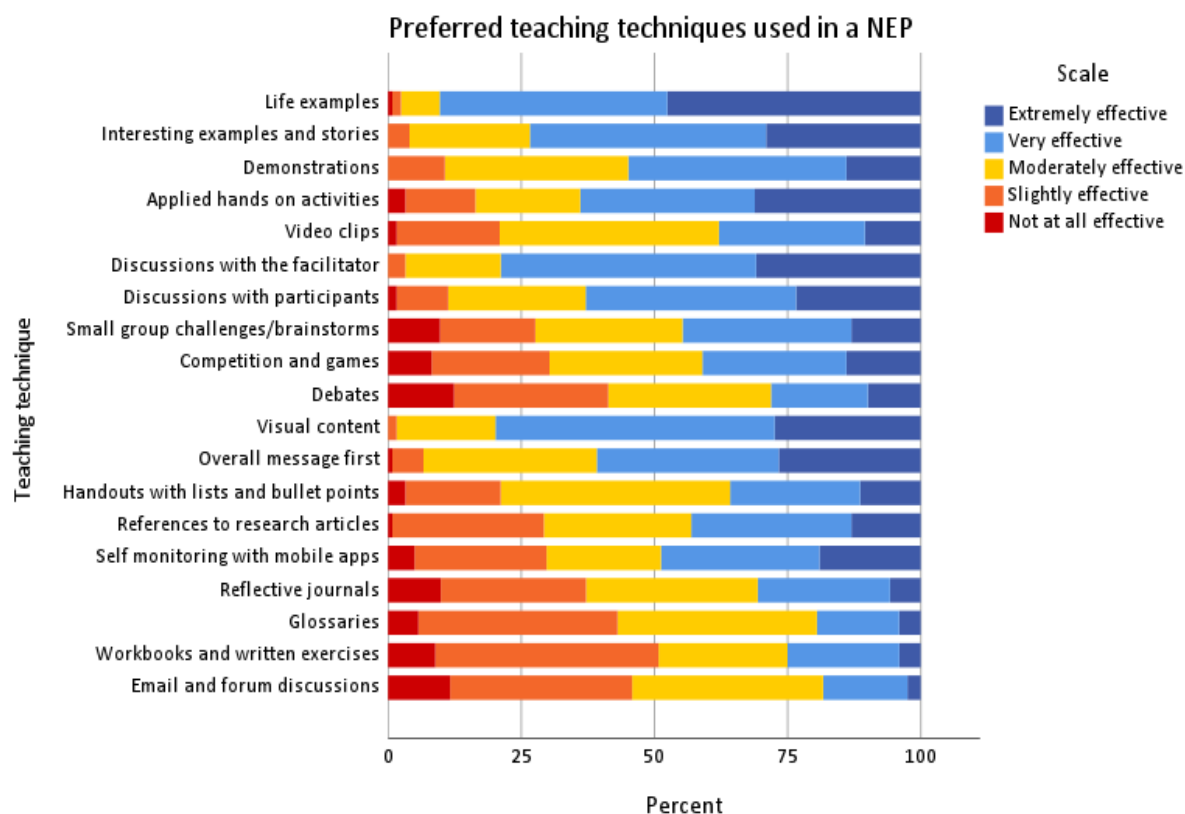


Figure 3.1 The percentage of athletes ($n=124$), who rated their perceived effectiveness of teaching techniques for learning in a NEP.

Techniques are grouped by learning styles: kinaesthetic, aural, visual, reading and writing.

Note: Not shown are unsure responses ($n=23$, 1%) for this section.

3.4.2.3 Monitoring and evaluation

Athletes thought setting nutrition goals was important (*moderately* 15.3%, *very* 52.4%, *extremely* 31.5%), however the need of these goals to be monitored by the facilitator was less important (*moderately* 33.1%, *very* 37.1%, *extremely* 16.1%). Athletes wanted some level of nutrition related two-way feedback between themselves and the facilitator (*very important* 48.4%, *extremely important* 26.6%).

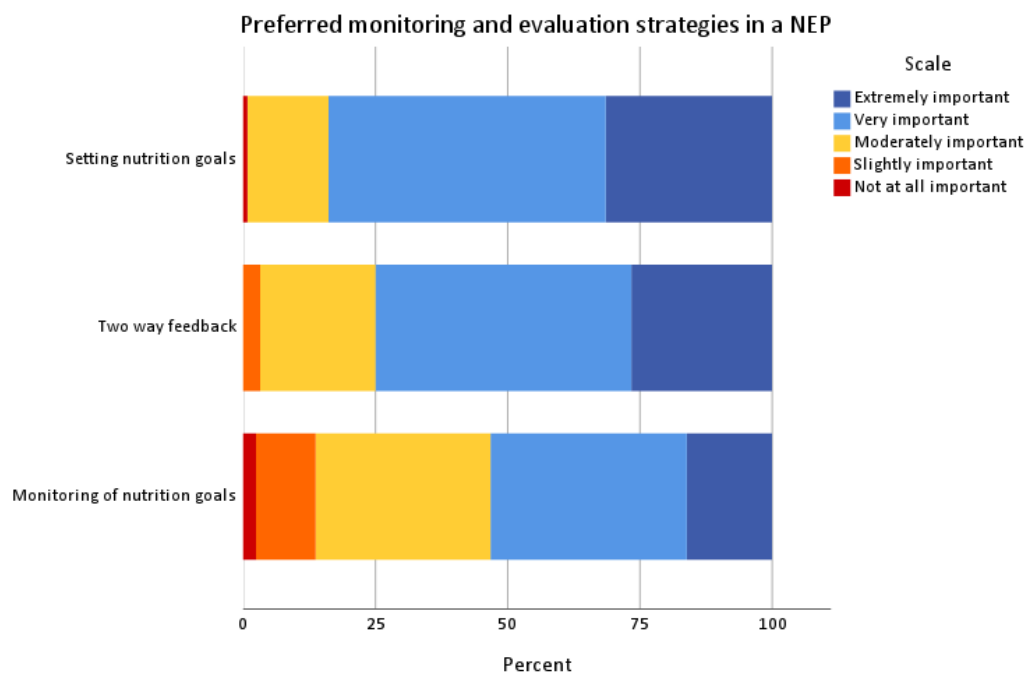


Figure 3.2 The percentage of athletes ($n=124$), and the importance of feedback and monitoring with the facilitator.

3.4.3 Format

3.4.3.1 Delivery characteristics

Preferred delivery settings were 'in person group sessions' (mean rank 4.66), followed by 'a combination of in person group and one-on-one sessions' (mean rank 4.55), and 'one-on-one sessions' (mean rank 4.48). The least preferred delivery settings were 'in person group sessions' or 'one-on-one sessions combined with online delivery' (mean rank 3.18 and 3.25 respectively), and an 'exclusively online delivery' (mean rank 3.77).

Webinars, podcasts, and emails (mean ranks 6.72, 5.59, 5.23 respectively) ranked as the top three preferred online delivery methods. Pre-recorded sessions available to watch in the athlete's own time were the most preferred method for delivering online content (mean rank 2.33). This was followed by live content (mean rank 2.28), and live recordings available for viewing in the athlete's own time (mean rank 1.38).

3.4.3.2 Demographic, participation, and temporal variables

Athletes preferred that NE sessions were shared with athletes of the same sporting calibre (61.3%), of similar age (52.4%), and coaches and teammates (both 51.6%).

*Table 3.4 Most preferred people to share NEP session with n=124**

Variable	n (%)
Athletes of the same sporting calibre	76 (61.3)
Athletes of similar age	65 (52.4)
Coaches	64 (51.6)
Teammates	64 (51.6)
Any athlete interested in performance nutrition	50 (40.3)
Athletes of the same gender	41 (33.1)
Athletes competing in the same sport	40 (32.3)
Teammates/friends who you are close with	38 (30.6)
Any person interested in performance nutrition	30 (24.2)
Personal support members (e.g., partner, family, parents)	29 (23.4)
Other†	1 (0.8)

*Multiple responses allowed. *Missing information (n=5, 4.0%).*

† Other response: "Dietitians that know a lot about the specific sport".

It was preferred that the NEP ran continuously throughout the year (50.8%), rather than intermittently (29.0%), or as a short course (16.1%) (missing 4.0%). For athletes who did not prefer the NEP to be continuous (45.2%), their preferences were for it to occur at the beginning of season (21.8%) or the off season (16.1%).

Six to ten people in both the in person and online environment was preferred. The most preferred duration and frequency for a single session was 31-60 minutes held once per month, for both in person group and online sessions. Overall, 6-10 sessions over the year were favoured.

Table 3.5 Session duration and contact frequency (n=124)

Session variable	In person group session, n (%)	Online session, n (%)
People in session*		
1-5	39 (31.5)	21 (16.9)
6-10	55 (44.4)	39 (31.5)
11-20	26 (21.0)	38 (30.6)
21-30	4 (3.2)	13 (10.5)
31-40	0 (0.0)	3 (2.4)
41-50	0 (0.0)	2 (1.6)

Session variable	In person group session, <i>n</i> (%)	Online session, <i>n</i> (%)
>50	0 (0.0)	7 (5.6)
Session duration		
<15mins	0 (0.0)	2 (1.6)
15-30mins	20 (16.1)	38 (30.6)
31-60mins	79 (63.7)	73 (58.9)
61-90mins	22 (17.7)	10 (8.1)
91mins – ½ day	2 (1.6)	0 (0.0)
Full day	1 (0.8)	1 (0.8)
Session frequency		
<1 every 2months	15 (12.1)	20 (16.1)
1 every 2months	39 (31.5)	33 (26.6)
1 per month	45 (36.3)	48 (38.7)
2 per month	19 (15.3)	15 (12.1)
1 per week	6 (4.8)	8 (6.5)
2 per week	0 (0.0)	0 (0.0)
Total sessions*		
1-5	47 (37.9)	44 (35.5)
6-10	47 (37.9)	47 (37.9)
11-20	21 (16.9)	24 (19.4)
21-30	5 (4.0)	6 (4.8)
31-40	2 (1.6)	1 (0.8)
41-50	1 (0.8)	1 (0.8)
>50	1 (0.8)	0 (0.0)

Session frequency: <1 every 2months = less than one session every two months; 1 per month = one session per month etc.

*Missing information for online session preferences: (n=1, 0.8%).

3.4.4 Content

General nutrition topics considered *essential* were energy requirements (58.4%), hydration (52.9%), nutrient deficiencies (43.3%), protein (40.4%), and carbohydrate recommendations (39.4%). The topics considered *not a priority* were food allergies (20.2%), safe alcohol use (14.4%), retiring from sport (10.6%), eating out (5.8%), and body image (4.8%).

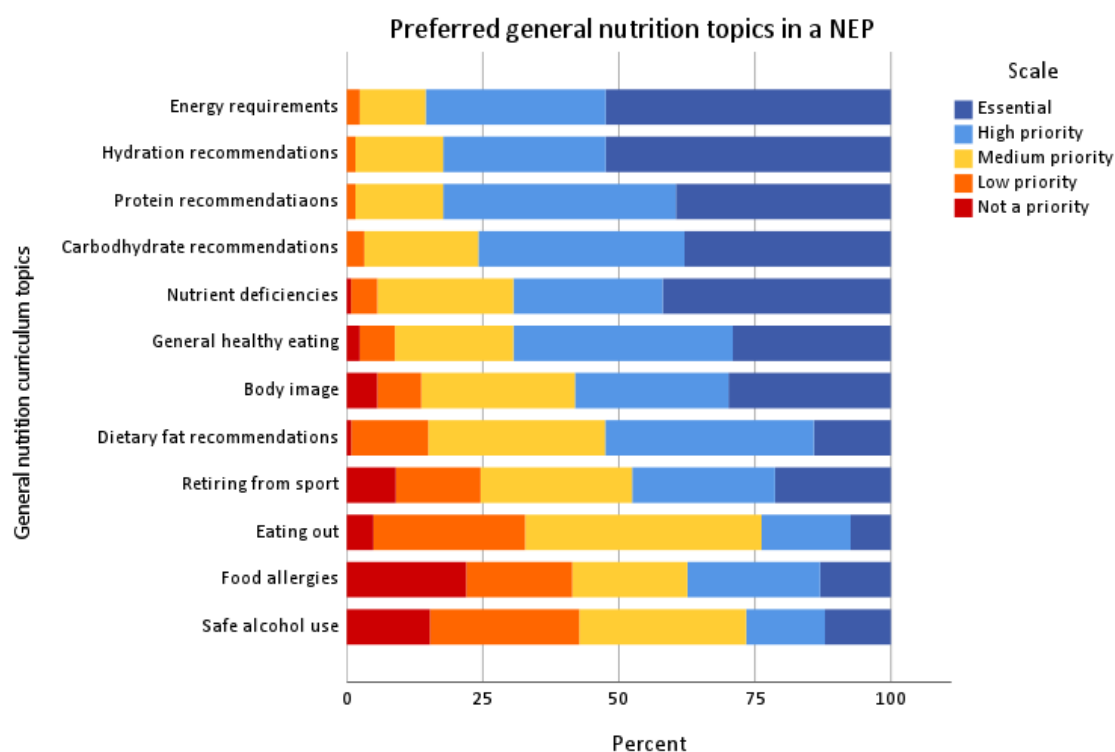


Figure 3.3 Priority of general nutrition curriculum topics to be included in a NEP (n=124).

Note: Not shown are unsure responses (n=9, 0.6%) for this section.

Performance nutrition topics considered *essential* priority were recovery nutrition (58.1%), pre and during exercise nutrition (51.6% and 50% respectively), as well as overall energy requirements (49.2%).

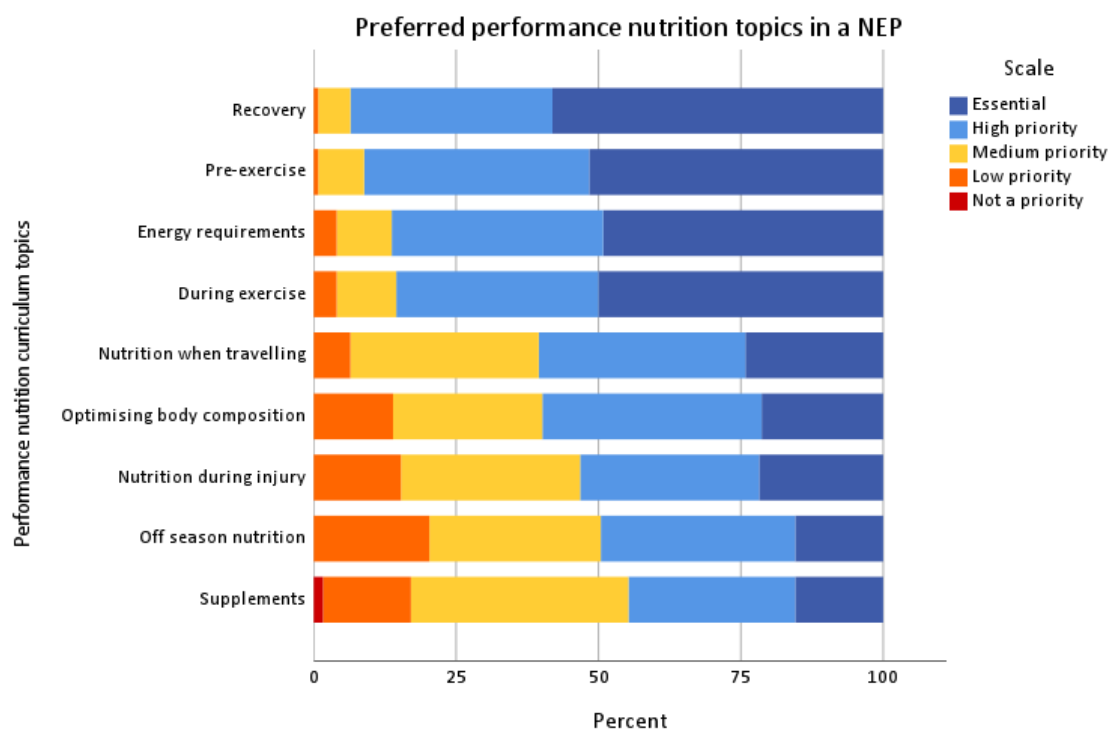


Figure 3.4 Priority of performance nutrition curriculum topics to be included in a NEP (n=124).

Note: Not shown are unsure responses (n=4, 0.4%) for this section.

Nutrition-related life skills were overall considered less *essential* compared to general and performance topics however they were still a medium to *high priority* to be included in a NEP for most athletes. The topics considered most *essential* were adapting meals for training requirements (37.9%) and behaviour change techniques (26.6%).

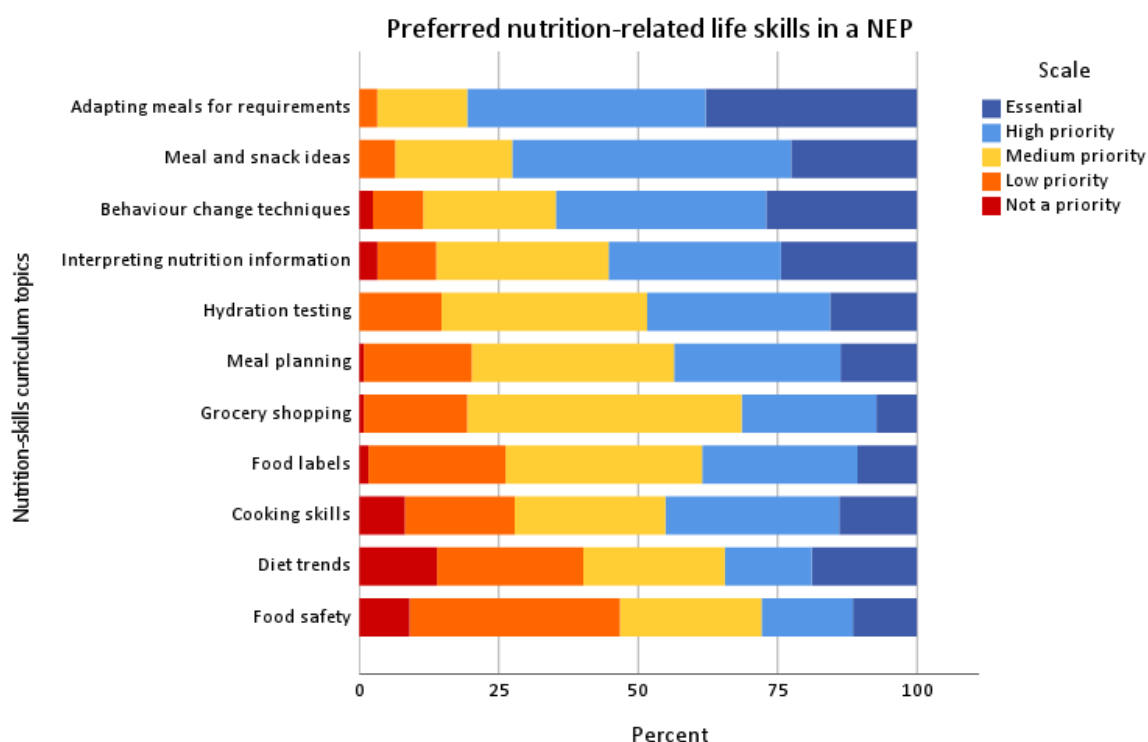


Figure 3.5 Priority of nutrition-related life skills to be included in a NEP (n=104). Note: Not shown are unsure responses (n=11, 0.8%) for this section.

3.4.4.1 Content characteristics

Credible content in a NEP was important for 91.1% (*always* 65.3%, or *often* 25.8%) of athletes. Most athletes felt that topics should be repeated *sometimes* (69.4%), with less athletes selecting topics should be repeated *often* (13.7%), *rarely* (12.1%), or *always* (4.8%).

3.4.5 Facilitator

The top three ranked people to facilitate a NEP were a sports dietitian or nutritionist (mean rank 4.09, p -value = <0.001), followed by a sport or exercise physiologist (mean rank 4.07), and an experienced athlete in the sport (mean rank 3.69). Least preferred were a team manager (mean rank 2.19), coach (mean rank 3.41) or fitness trainer/strength and conditioning coach (mean rank 3.54). Most athletes (82.3%) wanted the same facilitator *most* (62.1%) or *all of the time* (20.2%).

Top personality traits were that the facilitator be credible (73.4%), relatable and likeable (both 66.9%), with empathy (37.1%) and creativity (41.4%) being least important. Top relatability characteristics were that a facilitator be knowledgeable in the sport they are providing education in (85.5%) and are willing to learn more about the sport (71.0%). Being of similar age (4.8%), gender (5.9%), or having an athletic physical appearance (12.6%) were least important. Finally, a credible facilitator had experience in sports nutrition (76.6%), and/or was a registered nutrition professional (67.7%).

Table 3.6 Preferred qualities in a NEP facilitator (n=124)

Variable	n (%)
Personality traits	
Credible	91 (73.4)
Relatable	83 (66.9)
Likeable	83 (66.9)
Non-judgemental	82 (66.1)
Organised	79 (63.7)
Friendly	71 (57.3)
Trustworthy	71 (57.3)
Motivated	66 (53.2)
Creative	51 (41.1)
Empathetic	46 (37.1)
Other†	3 (2.4)
Relatability	
Knowledge of the sport	106 (85.5)
Willing to learn more about the sport	88 (71.0)
Prior experience as an athlete	72 (58.1)
Previous experience as an athlete in the sport	27 (21.8)
Athletic physical appearance	16 (12.9)
Same gender	11 (8.9)
Similar in age	6 (4.8)
Does not need to be relatable	3 (2.4)
Other‡	1 (0.8)
Credibility	
Experience in sports nutrition	95 (76.6)
Registered nutrition professional	84 (67.7)

Experience in nutrition with athletes of similar calibre	73 (58.9)
Experience in nutrition with similar sports	57 (46.0)
Bachelor's degree in nutrition	56 (45.2)
Experience in nutrition with the sport	44 (35.5)
Experience in general nutrition	37 (29.8)
Does not need to be credible	0 (0.0)
Other§	1 (0.8)

*Multiple responses allowed.

† Other responses: "Knowledgeable", "up to date on new nutrition gains", and "relevant".

‡ Other response: "Understand being a student (student budget)".

§ Other response: "Degree o[r] diploma, some holistic nutritionists don't have degrees but are equally capable."

3.4.6 Other/open question

The survey included one open ended question, asking the athlete "If you could describe your ideal nutrition education programme what would it be?". This question received 86 responses (see Appendix E). It was important to athletes that a NEP was individualised or tailored to the athlete ($n=6$), delivered with simple messaging ($n=4$), was fun ($n=4$) and engaging ($n=4$). Favoured teaching techniques were mentioned by 20 athletes, with kinaesthetic (e.g., hands on interactive activities) and aural (e.g., discussions) learning styles coming up most frequently, 11 times each. For the delivery of a NEP, 22 athletes wanted one-on-one sessions, while 27 mentioned group sessions (of these, 11 also wanted one-on-one sessions). Online was mentioned as a delivery method by 9 athletes, 7 of which want in conjunction with in-person sessions. Of the 15 athletes who mentioned frequency, 60% said they wanted sessions monthly or more. Session duration was mentioned by 4 athletes and ranged from 30-45 minutes. Athletes wanted to share their NEP with other athletes ($n=10$), those of the same gender ($n=4$), and age ($n=3$). The most commonly mentioned curriculum topics were training and competition nutrition advice ($n=7$), energy requirements ($n=5$), and in-season and off-season nutrition guidance ($n=4$). Nutrition related life skills were mentioned as a preferred part of the curriculum by 15 athletes, 11 of whom detailed a preference to learn more about meal/snack ideas and practical tips when making food choices. The credibility of the facilitator was important (mentioned by 16 athletes) to deliver science-based content.

3.5 Discussion

3.5.1 Overall findings

To our knowledge, this is the first study undertaken that has sought to quantify elite athletes' preferences specifically in pedagogy, format, content, and facilitator NE preferences. Athletes preferred an engaging NEP taught through a mixture of kinaesthetic, aural, and visual techniques. In

person group education with similar calibre athletes was the most preferred format, followed by a combination of group and individual sessions. Preferred length of sessions was 31-60 minutes, occurring monthly (6-10 sessions per year) as part of a continuously running NEP. Athletes valued most topics pertaining to general and performance nutrition, with adapting meal requirements being the most valued nutrition-related life skill. Finally, athletes valued a credible facilitator such as a performance dietitian or nutritionist with professional experience who was knowledgeable in the sport, and non-judgmental.

3.5.2 Pedagogy preferences

What counts as an engaging and effective teaching technique will likely depend on the preferred learning style of the individual (Fleming, 2001). The most preferred teaching techniques in this study were those that aligned with a kinaesthetic learning profile (e.g., life examples, and the use of interesting examples or stories). Braakhuis et al. (2015) also found a kinaesthetic learning style was the most dominant learning style in 93 elite and non-elite athletes who completed the visual, aural, read/write, kinaesthetic (VARK) questionnaire. McCauley et al. (2021) found kinaesthetic teaching techniques such as stories and real-life examples were preferred teaching techniques of elite athletes taking part in focus groups regarding preferences for NE. Visual education content, particularly the use of “charts, diagrams, and infographics” were another favoured teaching technique with 79.8% of athletes saying these were *very* or *extremely effective*. This may be one of the easier teaching techniques for NEP facilitators to adopt and was a preferred method used by 77% of sports nutritionists who participated in an online survey exploring perspectives around social media and usage (Dunne et al., 2019). Similar to the results of McCauley et al. (2021), most athletes did not favour reading or written tasks such as the use of workbooks and written exercises, with only 25% indicating these to be *very* or *extremely effective*. The use of aural learning through discussion was largely favoured by athletes in the present study. For athletes who value teaching techniques that incorporate engagement and open discussions, social media may be a valuable NE delivery tool provide athletes with want and need in their NEP to facilitate nutrition behaviour change (Bourke et al., 2019).

Setting performance nutrition goals was of *moderate* to *extreme importance* for 99.2% of the athletes in the present study. Fleming et al. (2005) in a text that explores athlete learning states that for athletes, having a clear set of goals supports quality learning. In a study in elite athletes aiming to gain weight for performance, goals were found to aid the athletes with motivation, and also compliance (Garthe et al., 2013). Taking time to understand the athletes’ preferred learning styles can be invaluable in designing what teaching strategies to utilise within a NEP.

3.5.3 Format

3.5.3.1 *Delivery characteristics*

Adopting traditional group lectures may be helpful in communicating overall key messages in the NEP, as well as helping to facilitate learning through open discussions with others. Group sessions were mentioned positively in 31.4% of the responses to the survey's open-ended question. Adopting group sessions were found to be athletes' preference in research by McCauley et al. (2021), especially for emphasising key messages and as a setting to stimulate discussions with the facilitator and/or other participants. That athletes ranked group sessions highly is encouraging, as the concern with one-on-one sessions is frequently around limited resourcing, where the role of the sports nutritionist is not just working with athletes, but also menu development, caterers, travel logistics, staff education and working with injured athletes (Bentley et al., 2019). In a NE intervention involving four one-on-one nutrition sessions between the athlete and nutritionist, 50% of the participants failed to complete all four individual counselling sessions (Nascimento et al., 2016). The researchers hypothesised this was due to the demanding schedule, a barrier often seen in the athlete population (Heaney et al., 2008). The combination of the practical difficulties for both the facilitator and athlete alike may mean a NEP relying on one-on-one sessions is not always an achievable and realistic option.

Group sessions, with the option for one-on-one sessions where feasible, is likely to work well for the sporting organisation whilst being a preferred option for athletes. Most interventions in the literature focus on either individual or group session formats of a heterogeneous nature, making them difficult to quantify (Boidin et al., 2020; Tam et al., 2019). There is even less evidence around the beneficial parameters for a mixed methods approach. A NE intervention in elite canoeists used a combination of group and individual sessions over one year, and while the results from 24 hour diet recalls found some improvements in dietary habits, not all messages from the NEP were adopted (Nowacka et al., 2016). Nascimento et al. (2016) found that despite a tailored curriculum, four face to face visits partnered with one group lecture did not improve the dietary habits in adult athletes. With differences in session durations and frequencies in interventions, more research is needed to fully understand the benefits and limitations of NEPs. This includes mixed method formats and how they can be implemented to have a positive impact on improving nutritional insufficiencies through behavioural change.

The preference for online delivery as a stand-alone option was ranked in the bottom three overall settings for the NEP delivery. Despite athletes commonly using social media to receive nutrition

information, findings from this survey found social media was not a preferred online delivery platform; rather their preference was for webinars. An online survey in New Zealand found that elite athletes were less likely than recreational athletes to use social media and rather utilised performance nutritionists provided by the national sports institution for NE (Bourke et al., 2019). This survey undertaken by Bourke et al. (2019) included 87 elite athletes, all eligible for performance support through High Performance Sport New Zealand (HPSNZ). Conversely, the present study defined 'eliteness' by competition at the national (35.5%), international age group (28.2%), and international open levels (29.8%). International open level athletes are the most likely to be receiving supplementary performance support in person, along with those competing professionally at the national level. Support available to the athlete will depend on the investment from the national sporting body. Therefore, when considering a NEP, the services already available to the athlete are likely to influence their preferred delivery format.

Athletes in this study all valued a NEP to be engaging to some extent which may contribute to the three most preferred learning environments to be in person. Research by Turner and Turner (2017) assessed the effectiveness of various delivery methods on tertiary student learning and found a mixture of in person and interactive online delivery methods to be significantly more effective than exclusively online delivery methods, aligning with the social presence theory that in person interaction is crucial for quality learning. It is apparent that engagement is important from both the athlete's view, and for the acquisition of knowledge and will need to be considered when designing a NEP.

3.5.3.2 Demographic, participation, and temporal variables

Most athletes wanted to share a NEP with athletes of the same sporting calibre (61.3%). A preference to share a NEP with teammates (51.6%) was not likely to apply to athletes in triathlon (7.3%), or auto racing (6%). Coaches were also some of the most preferred people to participate in the NEP (51.6%). Coaches were found to be the top source of nutrition information in this sample of athletes (71.8%), a finding like other studies in athlete groups (Devlin & Belski, 2015; Heaney et al., 2008; Shifflett et al., 2002; Zinn et al., 2006). While coaches' nutrition knowledge has been found to be better than that of athletes' (Torres-McGehee et al., 2012), there may be concern that without the nutrition training, a coach may put emphasis on body composition due to their primary focus for performance which could in turn stimulate stressors or personal triggers for the athlete (Bentley et al., 2021; Heaney et al., 2008; Heather et al., 2021; Trakman et al., 2016). While a coach was preferred to participate in a NEP, they

were one of the least preferred to facilitate a NEP (mean rank 3.41). Their role in NE should therefore be considered within the NEP to reflect these preferences.

Over a one-year period, athletes wanted 6-10 NE sessions overall, with athletes opting for slightly more sessions if delivered online. In a systematic review in non-athlete adults by Murimi et al. (2017), one of the major factors found in NEP's that created successful behavioural changes, was that the overall duration of the programme was greater than or equal to five months. However, there is a lack of NEP interventions in athletes of equal or greater duration in the current literature (Boidin et al., 2020; Tam et al., 2019). The total duration of the NEP may not be the most important element to improve dietary behaviour in athletes. One single arm study with a five month NEP found a significant improvement in the overall nutrition knowledge of elite level student athletes ($n=7$) but no improvements to dietary habits (Martinelli, 2013). In comparison, an intervention in female college athletes ($n=15$) designed to build the athlete's self-efficacy around dietary choices and improve nutrition knowledge, found significant improvements in the athlete's nutrition knowledge and self-efficacy from baseline over a two-month period (Abood et al., 2004). This lack of literature means it is difficult to quantify the optimal duration of NEPs for athletes.

3.5.4 Content preferences

General nutrition topics of *essential* or *high priority* were requirements for energy (85.5%), protein (82.2%), hydration (82.2%), carbohydrate (75.8%) and nutrient deficiencies (69.3%). In New Zealand there has recently been extensive media coverage regarding low energy availability in athletes, particularly in the rowing community (1News, Jun 9 2021; McFadden, Aug 17 2021). Given that rowers made up the largest cohort of athletes in the present study (26.6%), this may have influenced our findings with strong preferences for curricular topics related to athlete energy and nutrient requirements. Preferences regarding education for optimising body mass and composition were mixed, with 58.9% of athletes saying it was *essential* or *high priority* to include in a NEP. A common rhetoric in sport is for NE to focus on the manipulation of body composition. This may be driving athlete preferences for a more diverse education curriculum which includes discussion around interpreting nutrition information and behavioural change techniques (Bentley et al., 2021; McCauley et al., 2021).

Skills-based topics of *essential* or *high priority* were "adapting meals to suit performance requirements (e.g., increasing protein content of meals)" (80.6%) and "meal and snack ideas" (72.6%). Fewer athletes considered cooking skills to be an *essential* or *high priority* (44.3%). The inclusion of activities

such as cooking classes, supermarket tours, and nutrition related calculations is something athletes appear to respond positively to in the literature (Elias et al., 2018; Ellis et al., 2018; Patton-Lopez et al., 2018; Philippou et al., 2017). A NE intervention in female college athletes successfully improved dietary behaviours in athletes through the inclusion of self-efficacy in the intervention design. The final session (of eight) focused on “putting it all together” and provided opportunities throughout the programme for athletes to practice newly learned skills and apply them to their own lifestyles in ways that would offer the most benefit to them (Abood et al., 2004). Giving athletes the opportunity to practice new learnings is a way to create self-efficacy and improves behaviour change outcomes by improving the motivation and belief in the athlete’s capacity to perform a skill (Bentley et al., 2021). This was seen in the research by Abood et al. (2004) where positive dietary outcomes were seen following a NEP that included opportunities to apply learnings. Given that 41.9% of the athletes in this study lived at home or in a school boarding facility, cooking skills may not be a priority for these athletes. Consequently, there is a stronger preference for education on how to select and compose the most appropriate meals and snacks to support performance needs.

Popular diets may be attractive to athletes striving for a performance edge (Devrim-Lanpir et al., 2021) however, the elimination or restriction of any primary food group may pose disadvantageous effects for performance if done incorrectly. Including education pertaining to trending diets showed binary views across the athlete groups as both *low priority or not a priority* (39.5%) and *high priority or essential* (33.8%). This polarising response to “navigating diet trends (e.g., keto, vegan, carnivore, Mediterranean diet etc)” may be because the statement was covered for some athletes in a previous statement “interpreting nutrition information (e.g., myth busting, choosing credible sources)”. Covering this topic as part of the NEP may therefore be best offered as an optional education session for athletes with a strong interest in nutrition. However, covering it to some extent for all athletes may aid in ruling out temptation to follow unbalanced or respective ‘popular’ diets trending in the population (Heaney et al., 2008).

3.5.5 Facilitator

Athletes most valued that a NEP facilitator be credible (73.4%), with the most preferred facilitators being professionals such as a sports dietitian/nutritionist (mean rank 4.09), or a sport/exercise physiologist (mean rank 4.07). This preference to receive nutrition information from a dietitian was also seen in Australian team athletes (Trakman et al., 2019). Only 65.3% of athletes in the present study had experience working with a performance nutritionist, and 48.4% had received NE from a sports/exercise physiologist. There is reason to believe this preference depends on the athlete

demographic and prior NEP input. Simpson et al. (2017) found more time working with a performance nutritionists increased the athletes' preference for working with a performance dietitian/nutritionist. Additionally, athletes in the present study preferred facilitators with experience in sports nutrition (76.6%) and who had knowledge of the sport they were talking to (85.5%). Synonymous with the findings from the present study, recent research has found that athletes hold a higher preference for a credible facilitator who has knowledge of the athlete's sport, diverging from the previous rhetoric that the nutrition facilitator needed to physically look the part to gain the athlete's trust (McCauley et al., 2021; Mitchell et al., 2021). The facilitator's credibility as a professional, sports nutrition experience, and knowledge of the sport should all be considered in a NEP.

3.5.6 Future use of the survey and application of findings

The survey created for the purpose of this research was designed to be easy to complete by the elite athlete demographic yet thorough in detail to accommodate the design of a quality NEP. The survey presented in this research can be reused by future researchers and sporting organisations to further quantify athlete NE preferences. With many elite athletes in New Zealand utilising a performance nutritionist for their NE (Bourke et al., 2019), the ability for national sporting organisations and performance nutrition professionals to deliver education that promotes self-efficacy and behavioural change is of paramount importance. Furthermore, in athlete groups who do not have access to resources, the value of being able to tailor a NEP more effectively to the target athlete group offers value in quality and resources to both management and athletes. To improve the adoption of new dietary habits in athletes, this survey could be used alongside an athlete nutrition knowledge assessment tool such as that developed by Tam et al., (2020), and a food choice questionnaire to develop a NEP tailored to a particular athlete cohort such as the tool evaluated by Thurecht and Pelly (2021). Findings from this research can be used to guide the development of NEPs by both sporting bodies and the dietitian/nutritionist. The facilitator can take into account the many preferences from this research including: how to increase engagement by utilising desired teaching techniques and curricular topics, the demographic and number of athletes in a session, pedagogy and content preferences to develop athlete resources, desired facilitator traits and what qualities they may need to develop professionally.

3.5.7 Study strengths and limitations

This is a cross-sectional study, therefore only reflects athletes who chose to take part in the survey at a particular point in time. Furthermore, the survey was only available to athletes for 12.5 weeks. Setbacks to getting the survey out earlier included athlete and practitioner commitments in an

Olympic year. All recruitment in New Zealand and in parts of Australia was undertaken during strict government lockdown restrictions due to the COVID-19 outbreak. As a result, athletes were unable to do schooling or meetings in person and were instead forced to use online methods of communication/learning. Previously online methods of communication may have been seen as novel, however during this time it is a possibility that participants were experiencing screen fatigue which may have influenced their preference for the NEP setting (Veni Nella et al., 2020). Lockdown restrictions also meant that recruitment was all conducted through online means (i.e., email, Zoom meetings, social media etc).

The survey length was thought to be the biggest setback for response rate. The initial time commitment of the survey when it was first distributed was 15-20 minutes. Unfortunately, reengagement was not seen in many of the Australian athletes despite reminders that the survey had been shortened significantly to 10-15 minutes. New Zealand (and to some extent Australian) athlete recruitment was restricted by the researchers' personal connections with certain sports (namely rowing and triathlon), and while it was hoped athletes would share with other athletes across sports, this cross-selection is not a complete representation of all sports in New Zealand, making selection bias a limitation of this study. With volunteer sampling, it is more likely that athletes with a higher interest in nutrition (*very or extremely interested* 83.1%) were more inclined to participate. It should not be assumed that this is an accurate sample of the elite athlete population, and more research should be undertaken investigating the preferences in athletes with a moderate or less interest in performance nutrition. Offering the opportunity for a prize in return for completing the survey may have aided with uptake of athletes completing the survey.

Study strengths include the following: a good sample size ($n=124$), the ability to reach a wide range of athletes from various sports (including non-Olympic sports), and an easy to administer format that was both mobile and desktop compatible. The survey went through multiple phases in its development, including drawing from previous literature, pre-testing, and pilot testing with elite athletes. The scales used in Likert scale questions were designed to reduce acquiescence response bias by removing all agree/disagree scales and replacing them with more applicable response anchors.

3.5.8 Conclusion

Elite athletes who participated in the present study had a strong interest in nutrition topics and value credible information as part of an engaging NEP. This research found teaching through real life examples is preferred and is complemented with open discussions between the other participants and

the facilitator. Group in-person sessions and two-way feedback with the facilitator were highly valued by athletes as an interactive approach to NE. If online learning was to be included in the NEP, athletes preferred it be in combination with in-person group sessions and one-on-one learning. The online sessions should be webinars or podcasts that are pre-recorded, available for the athlete to watch/listen in their own time. Having small groups of 6-10 athletes of the same sporting calibre is preferred. For most athletes, a NEP would ideally run continuously throughout the year, or otherwise intermittently at the beginning of the season. Sessions would last 30-60 minutes in duration and be hosted monthly or every other month with 6-10 sessions over the year. Athletes want credible education on energy, hydration, protein, and carbohydrate requirements. They value topics relating to performance nutrition as a priority, particularly topics concerning recovery, energy, and pre- and during exercise requirements. Including nutrition-related life-skills in a NEP such as how to adapt meals to meet nutrition requirements, is a high priority for most athletes. A performance dietitian or nutritionist with experience in sports nutrition is preferred. The facilitator should be knowledgeable in the sport they are providing education for and have a willingness to learn more about it. Alongside credibility and relatability, the facilitator should be likeable and non-judgmental.

3.5.9 Acknowledgements

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4 Chapter Four: Discussion and Conclusion

4.1 Overview and achievement of the study aims and objectives

The present study aimed to quantify elite New Zealand and Australian athletes' preferences for nutrition education (NE) delivery. A survey was developed and distributed through convenience sampling to New Zealand and Australian athletes, where 124 complete responses were received. The survey was designed to ascertain preferred NE strategies among athletes. To date, minimal research has investigated athlete preferences for a nutrition education programme (NEP). It is yet to be quantified what the best approach in NE is to enable athletes to apply acquired knowledge to their current training and daily lifestyle. The findings from this study highlight the parameters to consider when designing a NEP from an athlete centred approach.

The most preferred teaching techniques were those that utilised kinaesthetic, aural, and visual learning styles. Taking the time to consider the preferred learning styles of the athlete group can enhance the comprehension of key messages in a NEP, allowing athletes to take on board new information and apply it. The survey developed for this research can be used as a tool to understand the athlete's preferences for teaching methods. While the visual, aural, read/write, kinaesthetic (VARK) learning styles questionnaire may lack validation for research, this tool can also be used to get a deeper understanding of the athlete's preferred learning style to guide the facilitator in the planning of teaching activities (Leite et al., 2010).

The combination of time and financial constraints for the facilitator and athlete alike may mean that a NEP relying on one-on-one sessions is not always the most achievable. Identifying ways to facilitate monthly in-person group sessions lasting 30-60 minutes, with 6-10 athletes of the same sporting level would appear to be athletes' preferred way to receive NE. Facilitators should endeavour to ensure their content can be easily individualised and is engaging for the participating athletes. While there was not a clear consensus, having 6-10 sessions over the course of the year allows for regular engagement opportunities and the repetition of key NE messages, to overcome barriers to change. This aligns with findings in a systematic review by Murimi et al. (2017), whereby non-athlete groups benefited from a NEP that was 5 months or longer. Despite these preferences, the temporal elements (dose and frequency) of the format may not be the most important factors for an effective NEP. Findings from past and present research are inconclusive about the most effective frequency (Boidin et al., 2020; Tam et al., 2019). Rather the content and learning outcomes of the programme, along with individual preferences of the athlete group and their training and competition schedule may be key factors to consider when designing a NEP. It is therefore advised that dietitians or nutrition

professionals looking to provide a NEP should consider the athlete's competition season to determine if it runs continuously, intermittently, or as a short course to get the best engagement from the athletes involved.

Nutrition-related life-skills preferred by athletes in this research were, adapting meals to meet requirements, menu planning, and meal and snack ideas. The opportunity to practice new learnings by including nutrition-related life skills in the curriculum, alongside repetition of key topics (energy recommendations, hydration recommendations, nutrition for recovery and nutrition for pre-exercise) may increase the athlete's capabilities and motivation needed to facilitate behavioural change (Abood et al., 2004; Bentley et al., 2021). Previous research would suggest that adding in skills-based topics in a NEP improves the athlete's capacity and motivation to apply changes (Bentley et al., 2021). Further evidence of this is seen in an intervention by Abood et al. (2004), who found that athletes who were given the opportunity to practice and apply newly learned skills improved their dietary habits. Therefore, when designing a NEP, dietitians may consider including sessions where athletes can practice adapting meals to meet their energy, hydration, recovery, and pre-exercise nutrition needs as part of a hands-on interactive workshop.

Athletes in this study preferred the facilitator to be a credible sports dietitian or nutritionist with experience in sports nutrition and a knowledge of the relevant sport. Having one consistent facilitator across a NEP can offer consistency in the nutritional messages and give athletes a chance to build a relationship with the educator, improving the two-way feedback process in meeting set nutrition goals.

A NEP that factors in the athlete's unique barriers is more likely to result in positive outcomes than an intervention that focuses on improving nutrition knowledge alone. However, with an overall lack of studies targeting behavioural change in NE interventions, understanding what behaviour change strategies are most effective to include in a NEP is yet to be established (Bentley et al., 2020). Qualitative research by Bentley et al. (2021) with both athletes and sports nutritionists outlines the importance of a NEP that creates opportunities for athletes to practice new learnings in a supportive environment (Bentley et al., 2019). This survey may be used in tandem with tools such as the Athlete Food Choice Questionnaire (Thurecht & Pelly, 2021), and athlete nutrition knowledge questionnaires (Tam et al., 2021), to understand and guide a design that is uniquely tailored to overcome athletes' barriers in adopting beneficial dietary habits.

4.2 Strengths and limitations

Key strengths of the present study were the ability to invite a large sample to participate in the study, and the ability to reach out to athletes competing at the national or international level in a wide range of sports (both non-Olympic and Olympic sports). The survey questions were guided by results from previous studies in health-related education such as nutrition and concussion that have been completed by athletes and non-athletes (Ashton et al., 2017; Beakey et al., 2020; Bourke et al., 2019; Braakhuis, 2015; Jenner et al., 2021; McCauley et al., 2021; Wiens et al., 2014) (see Appendix B). The survey was also thoroughly pre-tested and pilot tested. However, the length of the survey may have been a limiting factor in participant completion rate, along with the timing of the survey coinciding with the 2020 Tokyo Olympics which occurred in 2021. The survey was voluntary and resulted in a high percentage (83.1%) of participating athletes who were *very* or *extremely interested* in nutrition, therefore preferences of athletes less interested in nutrition are not well represented in this study. The researchers' personal connections to rowing and triathlon proved beneficial in reaching these athlete communities, however many sports in New Zealand and Australia were underrepresented as a result. Furthermore, due to the indirect recruitment methods (e.g., advertising over social media) it is difficult to know the true response rate received and to compare to the completion rate.

4.3 Final recommendations and conclusion

The findings of this research have enabled the formation of key recommendations for practitioners to use when designing or developing NEPs. The following are recommended for practitioners wanting to implement a NEP.

Pedagogy:

- Focus on a mixture of kinaesthetic, visual, and aural teaching techniques within a NEP to optimise engagement and consider asking the athletes what their preferred learning styles are.
- Incorporate teaching elements that include: real life examples, discussions with the facilitator, visual content including charts, diagrams, and infographics, and the use of interesting examples and stories.
- Encourage the athlete to set personal nutrition goals and offer two-way feedback with the facilitator for monitoring and support.

Format:

- Offer in-person group sessions in an interactive capacity for open discussions with peers and the facilitator.

- Target sessions to athletes of the same sporting calibre, hosted in small group sessions of 6-10 athletes lasting 30-60 minutes.
- Consider a continuous NEP of 6-10 sessions held monthly over the year, commencing at the start of the athlete's season.
- Offer webinar or podcast recordings of sessions for athletes to review in their own time.

Content:

- Include the following topics: recovery nutrition, pre-exercise nutrition, nutrition during exercise, energy requirements in general and training specific, hydration, protein, and carbohydrate recommendations.
- Incorporate skills-based topics that support the practise of adapting meals to meet nutrition requirements, and snack ideas relevant to the athlete's living situation (e.g., boarder vs flatting) etc.
- Consider the repetition of certain topics and key messages throughout the NEP to increase capability for behavioural change in athletes.
- Highlight the most important sessions and offer an outline of the NEP, so athletes can engage in further education if they have a high interest in the topic.
- As part of a NEP with credible content, cover popular diet trends as an option for athletes with a strong interest in nutrition.

Facilitator:

- Have a good understanding of the athlete's sport, or at minimum a willingness to learn more about it.
- High performance managers may want to consider preferred characteristics of a facilitator including personality traits of someone who is credible, relatable, likeable, and non-judgmental.
- Athletes value a credible facilitator, which they consider to be someone with experience in sports nutrition and/or a registered nutrition professional.

Alongside these recommendations for practitioners, further research could be undertaken to obtain a greater understanding of how best to engage athletes and optimise their dietary intake.

The following suggestions are recommended for future research on athletes' preferences in a NEP and to enhance understanding in this area:

- Undertake this survey in other athlete groups (e.g., different sports, levels of 'eliteness', different ages, countries).

- To improve survey uptake, replace the opening questions pertaining to current sources of NE with more direct and engaging questions on preferred curriculum topics. When undertaking the survey, aim to limit response bias if volunteer sampling is used. For example, offer an incentive for completing the survey to encourage athletes with a lower interest in nutrition to participate
- Consider adapting the current survey for other areas of the performance health management sector such as other sciences (e.g., physiology, psychology, biomechanics), and medicine and therapy (e.g., physical therapies, sports physicians). The survey may also be adapted for the general population (i.e., designing effective public health or NE interventions).
- Practitioners should be encouraged to evaluate and report on the effectiveness of NEP. For example, formal and informal feedback from athletes and key stakeholders, as well as changes in athlete's nutrition knowledge, self-efficacy, and dietary intake.

In conclusion, quality NE should empower the athlete with the self-efficacy and knowledge to apply dietary changes that will enhance their performance. Based on the population that participated and completed this survey, components to consider include the following: sports specific requirements of the target athlete group, teaching methods that cater primarily to kinaesthetic, aural and visual learning styles, delivery methods that are practical for the athlete and the sporting organisation, a mixture of essential and trending content, and a credible facilitator with knowledge of the sport. More research in this area would be beneficial to quantify temporal parameters in delivering a NEP (including mixed methods) and preferences for athletes who are less interested in nutrition and/or from a wider variety of sports.

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Appendices

Appendix A

Athlete survey

Page 1: Information Sheet

Page 2: Screening:

Are you:

1. 16 years of age or older
2. competing in your main sport at a national or international level

Page 3: Consent:

Please note that by completion and return of the questionnaire, consent is implied for the use of your answers by the research team.

Thanks for taking part in this survey. Let's get started!

Part 1/6: Nutrition Education Experience

How interested are you in learning more about performance nutrition?

- ☐ Extremely interested
- ☐ Very interested
- ☐ Moderately interested
- ☐ Slightly interested
- ☐ Not interested at all

Who or where have you received nutrition education from in the past? Please check all that apply:

- ☐ Doctor/nurse
- ☐ Sport/exercise physiologist
- ☐ Fitness/personal trainer or strength and conditioning coach
- ☐ Coach
- ☐ Manager
- ☐ Specialist sports dietitian or performance nutritionist
- ☐ Nutritionist or dietitian (other than sports specialist)
- ☐ Physical therapist e.g. physiotherapist, osteopath, soft tissue therapist
- ☐ Complimentary therapies e.g. naturopathy
- ☐ Secondary school curriculum
- ☐ University education
- ☐ Academic journals/nutrition textbooks
- ☐ Mainstream media (e.g. newspaper, TV, radio)
- ☐ Social media content (e.g. Instagram, Facebook)
- ☐ National sporting organisations or institutions

- ☐ Magazines/popular nutrition books
- ☐ Teammates/other athletes
- ☐ Friend/family member
- ☐ Internet media (e.g. general internet search)
- ☐ Gym staff
- ☐ Podcasts
- ☐ Chef
- ☐ Other (please specify)

Part 2/6: Content

Curricular Topics

How much of a priority to you is it that the following **general nutrition topics** are covered?

	<i>Not a priority</i>	<i>Low priority</i>	<i>Medium priority</i>	<i>High priority</i>	<i>Essential</i>	<i>Unsure</i>
General healthy eating / food group recommendations						
Protein recommendations						
Carbohydrate recommendations						
Dietary fat recommendations						
Energy requirements						
Nutrient deficiencies (e.g. iron)						
Hydration recommendations						
Guidelines on safe alcohol use						
Choosing takeaway foods/eating out						
Food allergy/intolerances						
Having a healthy body image						

	<i>Not a priority</i>	<i>Low priority</i>	<i>Medium priority</i>	<i>High priority</i>	<i>Essential</i>	<i>Unsure</i>
Nutrition after retiring from sport						

How much of a priority to you is it that the following **performance nutrition topics** are covered?

	<i>Not a priority</i>	<i>Low priority</i>	<i>Medium priority</i>	<i>High priority</i>	<i>Essential</i>	<i>Unsure</i>
Nutrition before practice or competition						
Nutrition during practice or competition						
Nutrition for recovery						
Optimising body mass and composition						
Energy requirements for training						
Supplement use						
Adjusting nutrition for the off-season						
Adjusting nutrition for injury						
Eating for performance while travelling						

How much of a priority to you is it that the following **nutrition-skills** are covered?

	<i>Not a priority</i>	<i>Low priority</i>	<i>Medium priority</i>	<i>High priority</i>	<i>Essential</i>	<i>Unsure</i>
Meal planning						
Grocery shopping						
Reading food labels						
Meal and snack ideas						
Cooking skills						
Adapting meals to suit performance requirements (e.g. increasing protein content of meals)						
Storing and cooking food safely						
Interpreting nutrition information (e.g. myth busting, choosing credible sources)						
Behaviour change to create and sustain healthy eating habits						
Hydration testing						
Navigating diet trends (e.g. keto, vegan, carnivore, Mediterranean diet etc)						

Part 3/6: Format

General Delivery

Ideally, a Performance Nutrition Education Programme should run:

- Continuously throughout the year (i.e. always running)
- Intermittently throughout the year (i.e. starts and stops at different times during the year)
- As a short course

→ If not continuous, where in the athletic year should your performance nutrition education take place?

- Off season
- Beginning of the season
- In season
- Other (please specify)

Who would you like to do your performance nutrition education sessions with? (check all that apply)

- ☐ Athletes of similar age
- ☐ Athletes of the same gender
- ☐ Athletes of the same sporting calibre
- ☐ Athletes competing in the same sport only
- ☐ Any athlete interested in performance nutrition
- ☐ Teammates
- ☐ Friends/teammates who you are close with
- ☐ Coaches
- ☐ Anyone interested in performance nutrition
- ☐ Personal support members (e.g. partner, family, parents)
- ☐ Other (please specify)

What is your **preferred setting** for a performance nutrition education programme? Please rank your TOP 3 by selecting the appropriate box (#1 being the most preferred for you)

	#1	#2	#3
In person group sessions (e.g. workshops/lectures)			
One-on-one sessions (online or in person)			
Online sessions (e.g. webinar, website content, mobile nutrition app)			

	#1	#2	#3
A mixture of in person group sessions and one-on-one sessions			
A mixture of in person group sessions and online delivery			
A mixture of one-on-one sessions and online delivery			
A mixture of in person group sessions, one-on-one sessions and online delivery			

In Person Group Sessions

Please tell us your preferences for an **in-person group session**:

	1-5	6-10	11-20	21-30	31-40	41-50	51+
Ideal number of people (including yourself) in the session(s)							
Total number of sessions over a year							

How long do you prefer each **in person group session** approximately runs for?

- ☐ Under 15 minutes
- ☐ 15-30 minutes
- ☐ 31-60 minutes
- ☐ 61-90 minutes
- ☐ 91 minutes - ½ day
- ☐ Full day
- ☐ Other (please specify)

How often do you prefer **in person group sessions** be held?

- ☐ Less than once every two months
- ☐ Once every two months
- ☐ Once per month
- ☐ Twice per month
- ☐ Once per week
- ☐ Twice per week

Online Delivery Sessions

Please rank your TOP 3 **online delivery methods** by selecting the appropriate box - 1 being your most preferred.

	#1	#2	#3
Webinars (e.g. Zoom meetings)			
Emails			
Podcasts			
Online forums			
Mobile application			
Social Media (e.g. Twitter, Instagram, Facebook)			
Online learning management/course delivery system (e.g. Canvas, Moodle)			
Website links to credible information and resources			
Other (please specify and rank individually if multiple)			

Please rank the following **online delivery methods** - 1 being your most preferred.

- Live
- Live recording and ability to watch in own time
- Pre-recorded and available to watch in own time

Please tell us your preferences for the following in an **online** performance nutrition education programme:

	1-5	6-10	11-20	21-30	31-40	41-50	51+
Ideal number of people (including yourself) in the online session(s)							
Total number of online sessions over a year							

How long do you prefer an **online session** approximately runs for?

- Under 15 minutes
- 15-30 minutes
- 31-60 minutes
- 61-90 minutes
- 91 minutes - ½ day
- Full day
- Other (please specify)

How often do you prefer **online sessions** be held?

- Less than once every two months
- Once every two months
- Once per month

- Twice per month
- Once per week
- Twice per week

Part 4/6: Facilitator

Personal attributes

What personality traits are important to you in a nutrition education facilitator (check all that apply)

- ☐ Creative
- ☐ Likeable
- ☐ Credible
- ☐ Relatable
- ☐ Empathetic
- ☐ Friendly
- ☐ Organised
- ☐ Motivated
- ☐ Trustworthy
- ☐ Non-judgmental
- ☐ Other (please specify)

For you to be able to **relate to** the facilitator they need (check all that apply):

- ☐ To be a similar age
- ☐ To be the same gender
- ☐ To have knowledge of your sport
- ☐ An athletic physical appearance
- ☐ Previous experience as an athlete
- ☐ Previous experience as an athlete in your sport
- ☐ A willingness to learn more about your sport
- ☐ The facilitator does not need to be relatable
- ☐ Other (please specify)

For a facilitator to be **credible** they should have (check all that apply):

- ☐ A Bachelor's degree in nutrition
- ☐ A registered nutrition professional (e.g. registered Dietitian, registered sports nutritionist)
- ☐ Prior experience in general nutrition
- ☐ Prior experience in sport nutrition
- ☐ Prior experience in nutrition with your sport
- ☐ Prior experience in nutrition with similar sports
- ☐ Prior experience in nutrition with athletes of similar calibre
- ☐ The facilitator does not need to be credible
- ☐ Other (please specify)

Qualification & Experience

Please rank your TOP 3 preferences for a facilitator - 1 being your most preferred.

	#1	#2	#3
Coach			
Manager			
Sports Dietitian or Nutritionist			
Sport and exercise physiologist			
Fitness trainer/strength and conditioning coach			
An experienced athlete in your sport			
Other (please specify and rank individually if multiple)			

Do you want the same person to deliver your nutrition education throughout your nutrition education programme?

- ☐ All of the time
- ☐ Most of the time
- ☐ About half of the time
- ☐ Some of the time
- ☐ Never, different facilitators are good

Part 5/6: Pedagogy

We have just a few questions left!

Engagement and enjoyment

For a performance nutrition education programme to be successful it needs to:

	<i>Never</i>	<i>Rarely</i>	<i>Sometimes</i>	<i>Often</i>	<i>Always</i>
Be enjoyable					
Be engaging					
Include credible content					
Include repetition of some topics					

Please tell us how effective you think the following **teaching techniques** are for your learning in a performance nutrition education programme:

	<i>Not at all effective</i>	<i>Slightly effective</i>	<i>Moderately effective</i>	<i>Very effective</i>	<i>Extremely effective</i>	<i>Unsure</i>
Handouts with written text including lists and bullet points						
Opportunities to explain or discuss new ideas with other participants						
Visual content including charts, diagrams, and infographics						
References to research articles						
Real life examples						
Discussions with the facilitator						
Glossaries and definitions						
Applied hands-on activities						
Small group challenges and brainstorming						
Use of interesting examples and stories						
Shown the big picture/overall message first						
Reflective journals						

	<i>Not at all effective</i>	<i>Slightly effective</i>	<i>Moderately effective</i>	<i>Very effective</i>	<i>Extremely effective</i>	<i>Unsure</i>
Self monitoring with mobile apps (e.g. My Fitness Pal)						
Demonstrations (i.e. see a task performed)						
Email or forum discussions and exchanges						
Workbooks and written exercises						
Watching related video clips						
Debates						
Competition and games (e.g., Trivia)						

Feedback and goals

Last question in this final section!

How important is it that the following aspects are included in your performance nutrition education programme:

	<i>Not at all important</i>	<i>Slightly important</i>	<i>Moderately important</i>	<i>Very important</i>	<i>Extremely important</i>
Performance nutrition related two-way feedback between you (the athlete) and the facilitator					

Setting personal performance nutrition goals					
Monitoring of personal performance nutrition goals by the facilitator					

Part 6/6: Background information

Last set of questions!

If you could describe your ideal nutrition education programme what would it be?

Which country do you live in?

- ☐ Australia
- ☐ New Zealand
- ☐ Other (please specify)

What is your age in years?

Which gender group do you identify with?

- ☐ Male
- ☐ Female
- ☐ Non-binary / gender diverse
- ☐ Prefer not to say
- ☐ Other

NEW ZEALAND:

What ethnicity(s) do you associate with (check all that apply):

- ☐ New Zealand European
- ☐ Māori
- ☐ Samoan
- ☐ Cook Islands Māori
- ☐ Tongan
- ☐ Niuean
- ☐ Chinese
- ☐ Indian
- ☐ Other (please specify)

AUSTRALIA/OTHER:

What ethnicity(s) do you associate with (check all that apply):

- ☐ Australian
- ☐ Indigenous Australian or Torres Strait Islander
- ☐ New Zealander
- ☐ Asian
- ☐ Indian
- ☐ Middle Eastern
- ☐ European
- ☐ Northern American
- ☐ Southern American
- ☐ African
- ☐ Other (please specify)

NEW ZEALAND

What is your highest level of education (this includes the education level you may be currently at)?

- ☐ School year 11 or lower
- ☐ School year 12 or 13
- ☐ Polytechnic
- ☐ University
- ☐ Other (please specify)

Do you have a Bachelor's degree or higher in Nutrition Science (or similar)?

- ☐ Yes, if yes please describe your qualification
- ☐ No

AUSTRALIA/OTHER

What is your highest level of education (this includes the education level you may be currently at)?

- ☐ School year 10 or lower
- ☐ School year 11 or 12
- ☐ TAFE
- ☐ University

- Other (please specify)

Do you have a Bachelor's degree or higher in Nutrition Science (or similar)?

- Yes, if yes please describe your qualification
- No

I currently live...

- with partner/spouse
- with parents/family
- in boarding school / university hostel
- with peers/housemates (NZ peers/flat mates)
- alone
- other (please specify)

My food is purchased by:

- Myself (e.g. personal supermarket shopping, *Hello Fresh* food delivery service, ready-to-go meals)
- Another member of the household
- Shared responsibility (e.g. parents/partner/housemates and self)
- A food service organisation (e.g. dorm style living)
- Other (please specify)

My food is prepared/cooked by:

- Myself (e.g. personal supermarket shopping, *Hello Fresh* food delivery service)
- Another member of the household
- Shared responsibility (e.g. parents/partner/housemates and self)
- A food service organisation (e.g. dorm style living)
- Other (please specify)

Do you currently have any special dietary requirements that need to be considered in your performance nutrition education? (e.g. type 1 diabetes, coeliac disease)

- Yes
- No

→ If yes, please specify

Are you a para-athlete

- Yes
- No

Yes → What is your main sport or event (where relevant)?

- Alpine skiing
- Archery
- Athletics
- Badminton
- Biathlon
- Boccia
- Canoe
- Cross-country skiing
- Cycling
- Equestrian
- Football 5-a-side
- Goalball
- Ice Sledge Hockey
- Judo
- Powerlifting
- Rowing
- Sailing
- Shooting
- Sitting volleyball
- Swimming
- Table tennis
- Taekwondo
- Triathlon
- Wheelchair basketball
- Wheelchair curling
- Wheelchair dance sport
- Wheelchair fencing
- Wheelchair rugby
- Wheelchair tennis
- Other (please specify)
- *No* → What is your main sport or event (where relevant)?
- Alpine skiing
- Archery
- Australian rules football
- Auto Racing → *open text what is your main race class?*
- Badminton
- Basketball
- Biathlon
- Beach volleyball
- Bobsleigh
- Boxing
- Curling
- Cross country skiing
- CrossFit
- Cycling - *Track; Road; Mountain bike; BMX*
- Dance - *Ballet; Jazz; Tap, Hip hop*
- Decathlon
- Diving
- Equestrian
- Fencing
- Figure skating

- Freestyle skiing
- Golf
- Gym / weight training
- Gymnastics – *Artistic; Rhythmic*
- Handball
- Heptathlon
- Hockey
- Horse racing / jockey
- Ice hockey
- Judo
- Jumping - *Triple jump; Long jump; High jump; Pole vault*
- Karate
- Kayaking / canoeing
- Luge
- Modern pentathlon
- Netball
- Nordic combined
- Race walking
- Rowing - *Open weight; Light weight*
- Rugby
- Rugby league
- Rugby sevens
- Running - *10km; Half marathon; Marathon; Cross country*
- Sailing
- Shooting
- Short track speed skating
- Skeleton
- Ski jumping
- Snowboard
- Speed skating
- Sprinting - *100m; 200m; 400m; 110m hurdles; 400m hurdles*
- Soccer / Football
- Squash
- Swimming - *Pool, Open water*
- Synchronised swimming
- Table tennis
- Taekwondo
- Tennis
- Track – *800; 1500m; Mile; 3000m steeplechase; 5000m*
- Trampoline
- Triathlon → *Sprint distance 750m swim, 20km cycle, 5km run; Olympic / standard distance – 1.5km swim, 40km cycle, 10km run; Long distance 4km swim, 120km cycle, 30km run; Half iron man 1.9km swim, 90km cycle, 21.2km run; Ironman 3.8km swim, 180km cycle, 42.2km run*
- Water polo
- Weightlifting → *Bantamweight, featherweight, lightweight, middleweight, middle-heavyweight, heavyweight, super heavyweight*
- Wrestling
- Volleyball
- Other (please specify)

For your main sport / event, what is the highest level you participate / compete in?

- ☐ National
- ☐ International - age group
- ☐ International – open
- ☐ Other (please specify)

How many years have you been competing at the highest level as described above (e.g. national or international level) sport in total?

- ☐ 1-3 years
- ☐ 3-5 years
- ☐ 5-10 years
- ☐ 10+ years

Appendix B

Survey justification

Part 1: Nutrition Education Experience

Question	Preferences explored	Phrasing logic
How interested are you in learning more about performance nutrition? ○ Extremely interested ○ Very interested ○ Moderately interested ○ Slightly interested ○ Not interested at all	As per the guidelines by Blair et al. (2014), introductory questions were designed to be • Easy for the participant to draw on past experiences. • Simple to answer and call on the participant's existing available knowledge. • Interesting for the participant. • Relevant to the central topic It was important for the participant to be able to identify with these questions and refer to their personal experiences in performance nutrition (Blair et al., 2014; Martin, 2005). Ensuring the questions encouraged participant uptake was important as previous studies suggest that athletes with greater interest in nutrition are more engaged in discussion on nutritional preferences (McCauley et al., 2021).	Introductory questions in the survey are item specific rather than unipolar or bipolar Likert scale questions. This was to ensure the questions were more straightforward for the participant to answer, which in turn results in more reliable data (Blair et al., 2014; Höhne & Lenzner, 2018).

Question	Preferences explored	Phrasing logic
Who or where have you received nutrition education from in the past? Please indicate how many hours of nutrition education you have had from these sources:	This question covers background information relevant to the central topic (Blair et al., 2014). Primary sources of nutrition information for athletes are included in this list of topics based on the findings of studies in athletes (Devlin & Belski, 2015; Heaney et al., 2008; Jenner et al., 2021; Renard et al., 2020; Trakman et al., 2019; Wiens et al., 2014; Zuniga et al., 2017). The influence of previous dietetic input is relevant to the primary objective of this study, with prior learning affecting new learning (Fleming et al., 2005; Spronk et al., 2015).	Not expecting the participant to know precisely how much formal nutrition education (NE) they have had, these questions were designed to obtain categorical data to understand the participant's past experiences. The responses were therefore collected based on absolute frequencies of time. Originally there were three questions, "have you received NE in the past?", "if yes, who or where did you receive your nutrition education from?", and "where do you currently get your nutrition information from?". To reduce participant burden, the two questions were consolidated. Rather than using a one-year timeline as used by Bourke et al. (2019), the question was left open to find out their overall exposure to NE rather than focusing on recent or past.

Part 2: Content

Curricular Topics

Question	Preferences explored	Phrasing logic
How much of a priority to you is it that the following topics are covered? → General Nutrition → Performance Nutrition	This question included the following topics from the model by Parks et al. (2016) where curricular topics are categorised by basic nutrition concepts, performance related topics and food skills. Topics included in the survey from this model include: - Hydration recommendations - Guidelines on safe alcohol use - Meal timing and frequency - Having a healthy body image Topics from athlete focus group discussions (McCauley et al., 2021), and feedback from pretesting and pilot testing of the survey was also included.	Use of unipolar, item-specific response questions used over agree/disagree rating scales. Studies have found that responding on an agree/disagree scale requires more cognitive steps to form an answer, increasing the likelihood for participants to agree with statements to take shortcuts, resulting in less reliable data (Höhne & Lenzner, 2018; Saris et al., 2010). There is inconclusive evidence on the optimal number of responses for Likert scales. Less than or greater than five provides a (debatably) less beneficial response quality than five (Asún et al., 2016; Leung, 2011; Revilla et al., 2014; Saris et al., 2010) (Höhne & Lenzner, 2018).

Question	Preferences explored	Phrasing logic
How much of a priority to you is it that the following nutrition-skills are covered? • Meal planning, • Grocery shopping, • Reading food labels, • Meal and snack ideas, • Cooking skills, • Adapting meals to suit performance requirements, • Storing and cooking food safely, • Interpreting nutrition information, • Behaviour change to create and sustain healthy eating habits, • Hydration testing, • Navigating diet trends.	The literature has shown that athletes often prefer hands on activities (Levy & Auld, 2004; Parks et al., 2016) (Martinelli, 2013; McCauley et al., 2021; Morgan et al., 2016; Philippou et al., 2017). Listed options for nutrition-related skills are based off previous interventions and NE models (Collison., 1996; McCauley et al., 2021; Parks et al., 2016; Philippou et al., 2017).	The potential time burden of having many questions in this matrix table style was considered. Offering five response options aimed to allow participants to express how much of a priority each skill was, without sacrificing the quality of the results (Asún et al., 2016; Revilla et al., 2014). Other NE studies have investigated important nutrition topics in collegiate athletes using a 1-5 Likert scale of importance (Zuniga et al., 2017). It was important that the questions in this survey were direct in asking the participant <i>their</i> personal preferences. For this reason, a scale of personal priority for each topic was used following pretesting (Vagias, 2006). A sixth option was added following pre and pilot testing allowing athletes to select “unsure”. This was due to feedback from athletes during pretesting.

NE = nutrition education

Part 3: Format

General Delivery

Question	Preferences explored	Phrasing logic
Ideally, a Performance Nutrition Education Programme should run: ○ Continuously ○ Intermittently ○ Short course If not continuous, where in the athletic year? ○ Off season ○ Beginning of season ○ In season ○ Other	The athlete's preference for nutrition education programme (NEP) delivery time may depend on the athlete's sporting season (McCauley et al., 2021). The sporting season has also been found to influence the athletes' food choices, potentially calling for the need of specific NE relevant to the time in the competition cycle (Jenner et al., 2021).	
Who would you like to do your performance nutrition education sessions with? (check all that apply):	Athlete's preferences for attendance in the NEP to be with athletes of the same sport, friendship groups, and/or groups separated by gender, varied between individual athletes versus team sport athletes (McCauley et al., 2021). More than 40% of athletes in concussion education surveys preferred the coach to be involved in sport-related	The research team had many discussions during pretesting to make the wording of this question as simple and direct as possible. This question was originally an agree-disagree matrix table. However, it was changed to a multiple selection multiple choice question to reduce the overall number of matrix tables in the survey. Matrix tables with Likert scales require more decisions to be

Question	Preferences explored	Phrasing logic
	concussion education (Beakey et al., 2020; Kroshus & Baugh, 2016).	made by the participant, so removing one was done to shorten the survey completion time (Höhne & Lenzner, 2018; Saris et al., 2010).
What is your preferred setting for a performance nutrition education programme? Please rank your TOP 3 by selecting the appropriate box (#1 being the most preferred for you)	Delivery methods in NE interventions vary greatly, as found in the systematic reviews by Tam et al. (2019) and Boidin et al. (2020). Face-to-face delivery is the most used delivery method in nutrition intervention studies (Boidin et al., 2020; Tam et al., 2019). This question recognises that not all programmes are able to facilitate individual counselling, and so offers other preferred settings (Torres-McGehee et al., 2012). Online education is included as it provides a flexible option with regards to the athlete's schedule, and therefore may decrease barriers to access (Nascimento et al., 2016). Research with athletes in focus groups has shown some preferences for a multimodality NEP, which is why it is included as an option (Ashton et al., 2017; McCauley et al., 2021).	A rank order question was initially used to prioritise athlete preferences in the results. Using a rank order question avoids acquiescence response bias commonly found with rating scale questions and adds variety in the overall survey design. However, it was difficult for participants to rank all seven options. This was changed to a matrix table, asking the participants to instead only rank their top three options, using the questionnaire by Schwarz et al. (2021) as a guide.

Question	Preferences explored	Phrasing logic

NE = nutrition education, NEP = nutrition education programme

In person group sessions

Question	Preferences explored	Phrasing logic
Please tell us your preferences for an in-person group session: • Ideal number of people (including yourself) in the session(s) • Total number of sessions over a year	Preferences in focus group athletes were for both smaller or larger groups depending on whether they were individual or team sport athletes, with an ideal range around 6-10 people (McCauley et al., 2021). The preference for the total number of sessions varied among focus group athletes (McCauley et al., 2021).	This is the largest section in the survey (Part 3/6: Format), and has been broken up with page breaks to optimise participant engagement rather than having one continuous scroll for the full section (Couper, 2008). Initially this question was an ordered response question, with an interactive numerical scale to collect information on both the number of people and total number of sessions. This numerical scale was used in place of a five-point Likert scale to increase the diversity of the style of survey questions (as per pretesting feedback), omitting a middle category with the hope of more accurate data. Considering athletes who have had little previous NE exposure may not yet have formed an opinion on their preferences for such a question (as seen by McCauley et al. (2021)), the question format was changed back to an

Question	Preferences explored	Phrasing logic
		ordered response matrix table to lessen the likelihood of skewed data from the numerical scale chosen on the slider scales. The final survey used ordinal numerical ranges to obtain an idea of the athlete's preferences, as opposed to asking the athlete to pick one specific number. Fifty-one plus is chosen as the final item on the scale, as elite sports teams (including athlete squad, coaches, and support people) are unlikely to exceed this number. Furthermore, an audience of more than 50 people is difficult to facilitate as an interactive group session, and rather the session becomes more of a lecture style. Fifty also fits for the final statement, working in with one session per week over a year.
How long do you prefer each in person group session approximately runs for?	The heterogeneity across NE interventions found in systematic reviews includes the amount of NE the participant groups are exposed to (Boidin et al., 2020; Tam et al., 2019). Preferences for session duration ranged from 30 to 60 minutes for a single session, with an overall	Ordered responses are written as absolute frequencies to understand preferences regarding both the session duration and contact frequency in the NEP. Each question is ordered from the least amount of time or frequency, to the most.

Question	Preferences explored	Phrasing logic
How often do you prefer in person group sessions be held?	preferred frequency of one session a month in athlete focus groups (McCauley et al., 2021).	It was recognised by the researchers that participants may not select 'in person session' or 'online' as one of their top three preferred options. It was however decided that it was important to still quantify temporal and demographic preferences surrounding these options for all athletes, as some sporting programmes may be restricted by resources and unable to perform online or one-on-one sessions.

NE = nutrition education, NEP = nutrition education programme

Online delivery sessions

Question	Preferences explored	Phrasing logic
Please rank your TOP 3 online delivery methods by selecting the appropriate box - 1 being your most preferred.	Options for the preferred delivery method are included from various NE interventions, including mobile applications (Simpson et al., 2017; Zuniga et al., 2017), podcasts (Turner-McGrievy & Tate, 2011), social media (Coccia et al., 2020), and emails (Buffington et al., 2016). Social media is included as it is a platform that younger athletes are likely to utilise for their nutrition information	Rank order question have been used to prioritise athlete preferences in the results. Using a rank order question avoids acquiescence response bias commonly found with rating scale questions and adds diversity with a different style of interaction to the overall survey design.

Question	Preferences explored	Phrasing logic
	(Zuniga et al., 2017). Though it was initially included, the survey did not ask the athlete their preferred platforms of social media. Improved nutrition knowledge was found in college athletes utilising Twitter, however a limitation was that Twitter was not used by all participants ordinarily (Coccia et al., 2020). This question in the survey was removed to shorten the survey, and to focus on the research objectives more broadly.	
Please rank the following online delivery methods - 1 being your most preferred. • Live • Recorded • Pre-recorded	Live versus video recording helps quantify the importance of flexibility within the NEP for the athlete.	A click and drag style ranked question provided some variety in the response style for the participant.
Please tell us your preferences for an in-person group session: • Ideal number of people (including yourself) in the session(s)	Despite having an idea of athlete preferences for in-person delivery sessions, little is known regarding athlete preference for online delivery.	Single answer multi-choice question with ordinal numerical ranges was used to get an idea of the athlete's preferences specific to online delivery.

Question	Preferences explored	Phrasing logic
Total number of sessions over a year		
How long do you prefer an online session approximately runs for? How often do you prefer online sessions be held?	As with in-person delivery, the preferences were explored specific to online NE sessions.	Ordered response as absolute frequencies was used to understand preferences on session duration and contact frequency. Each question is ordered from the least amount of time or frequency, to the most.

NE = nutrition education, NEP = nutrition education programme

Part 4: Facilitator

Personal Attributes

Question	Preferences explored	Phrasing logic
What personality traits are important to you in a nutrition education facilitator (check all that apply)	Listed are facilitator qualities found to best engage participants in NE (Bentley et al., 2021; McCauley et al., 2021; Morgan et al., 2016; Schwarz et al., 2021). Focus group discussions with athletes found no preference in the aesthetic appearance of the facilitator (McCauley et al., 2021). Athletes are more likely to engage with a facilitator who has knowledge or shows interest in learning	The wording of each question refers to the athlete's personal preferences. Multiple response multiple choice questions were used to allow for all qualities preferred by the athlete to be collected.

Question	Preferences explored	Phrasing logic
	more about the relevant sport (McCauley et al., 2021; Schwarz et al., 2021).	
For you to be able to relate to the facilitator they need (check all that apply)	Morgan et al. (2016) identified relatability as a key quality for the facilitator. Preferences may depend on the participant's age, as collegiate athletes were found to prefer informal friendly sessions with graduate nutrition students as their facilitator (Kicklighter et al., 2010).	
For a facilitator to be credible they should have (check all that apply)	Credibility is recognised as a key quality in a NE facilitator by athletes (Morgan et al., 2016; Rastmanesh et al., 2007; Simpson et al., 2017). However, what counts as credible is likely to mean different things to different athletes (McCauley et al., 2021).	

NE = nutrition education

Qualification & Experience

Question	Preferences explored	Phrasing logic
Please rank your TOP 3 preferences for a facilitator - 1 being your most preferred.	Facilitator preferences can be influenced by the athlete's previous experience (Rastmanesh et al., 2007; Schwarz et al., 2021; Simpson et al., 2017). The preference for the facilitator may also be influenced by the relationship athletes have with support members, and if they value a formal approach from the facilitator (Kicklighter et al., 2010).	Rank order question is used to prioritise athlete preferences in the results. As with earlier questions in the 'Format' section, this question accommodates for the recognition that not all programmes are able to employ full time support members from the various disciplines, therefore the ranked style questions allow for the consideration of the next most preferred setting.
Do you want the same person to deliver your nutrition education throughout your nutrition education programme?	It has been suggested that having one key facilitator can help ensure the NEP sessions are optimally placed for the athletes within their season (Parks et al., 2016).	A five-point, unipolar, item-specific response question is used with response anchors in relative frequencies of time (Vagias, 2006).

NEP = nutrition education programme

Part 5: Pedagogy

Engagement and enjoyment

Question	Preferences explored	Phrasing logic
For a performance nutrition education programme to be successful it needs to be: • Enjoyable • Engaging • Include credible content • Include repetition of some topics	The work by Morgan et al. (2016) details the importance of a NEP to be both enjoyable and engaging. This is supported by athletes responses in focus groups (McCauley et al., 2021; Simpson et al., 2017). Avoiding repetition in the curriculum content was discussed by focus group participants as a barrier to engagement (McCauley et al., 2021) This question aims to again quantify athlete's preferences, from athlete feedback gained in qualitative research (Ashton et al., 2017; Levy & Auld, 2004; McCauley et al., 2021; Parks et al., 2016).	A five-point, unipolar, item-specific response questions in relative frequencies of time is used (Vagias, 2006).
Please tell us how effective you think the following teaching techniques are in a performance nutrition education programme:	Different audiences are likely to have different preferences for receiving information, for this reason a range of different learning styles was included as options and listed to accommodate for personal differences (Barker-Ruchti,	Effective teaching technique preferences were questioned using a five-point Likert scale for various pedagogy strategies both used in general teaching and athlete specific NE interventions (Barker-Ruchti, 2019). Anchors of effectiveness were based on the five-point level of

Question	Preferences explored	Phrasing logic
	2019; Bourke et al., 2019; Francis & Taylor, 2009; McCauley et al., 2021). Teaching techniques listed are a mixture of visual, aural, writing/reading, and kinaesthetic learning styles as per the VARK learning preferences by Neil Fleming (Fleming, 2001; Fleming, 2002; Fleming et al., 2005).	satisfaction from Vagias (2006). The middle section was avoided as being “neutral”, encouraging the participant to express an opinion and the intensity to that opinion. However, an “unsure” option was added in the final column, to account for participant who had not had exposure to any of the listed technique and could therefore not give an opinion.

NE = nutrition education, NEP = nutrition education programme, VARK = visual, aural, read/write, kinaesthetic

Feedback and Goals

Question	Preferences explored	Phrasing logic
Importance of Performance nutrition related two-way feedback between you (the athlete) and the facilitator	This question is included because feedback is a primary element of the learning process, particularly when it comes to the ability to equip the learner with a stronger capacity to self-direct their performance (Nicol & Macfarlane-Dick, 2006). This question gave athletes the opportunity to indicate their preferences relating to nutrition support to assist their desired dietary intake and habits (Jenner et al., 2021).	Five-point, item-specific response questions for evaluative ratings of importance used (Vagias, 2006).

Question	Preferences explored	Phrasing logic
	Feedback has been expressed by athletes as a desired component of NE from the facilitator (Ashton et al., 2017; McCauley et al., 2021).	
Importance of setting personal performance nutrition goals	Setting goals is an important process to achieving performance targets. Goals also have a role in athlete compliance of diet quality and motivation to make supportive food choices (Garthe et al., 2013; Jenner et al., 2021; McCauley et al., 2021).	
Monitoring of other personal performance nutrition goals by the facilitator	Monitoring of nutrition goals was included due to its key part in any nutrition intervention. Researchers in nutrition interventions have found monitoring goals to aid in athlete's success (Garthe et al., 2013). Yet whether athletes have a preference for this to be included in their NEP is not unanimous in elite athletes (McCauley et al., 2021).	

NEP = nutrition education programme

Part 6: Background information

The NEP needs to be designed around its target audience. Understanding the age, setting, sporting advancement of the athlete and athlete group is key to understanding their responses to the questions detailed in the tables above.

Question	Preferences explored	Phrasing logic
If you could describe your ideal nutrition education programme, what would it be?	This was added in to give the athlete an opportunity to voice any opinions they had, and that they felt were not covered in the survey. This has been done similarly in questionnaires regarding athlete use of social media for nutrition information by Bourke et al. (2019).	Personal demographic questions were asked at the end of the survey so as to not begin with questions that can trigger the participant/s to reconsider the confidentiality or the survey (Blair et al., 2014; Martin, 2005).
Which country do you live in? ○ Australia ○ New Zealand ○ Other (please specify)		
Age in years Gender group	Literature indicates differences in education preferences between female and male groups, along with masters/seniors compared to junior/developmental athletes (Beakey et al., 2020; Braakhuis et al., 2015; Fleming et al., 2005; Nascimento et al., 2016; Wiens et al., 2014).	
Ethnicity(s)	Classifications were grouped as per the Australian Bureau of Statistics (2019) guidelines (a more extensive list than	Though a dropdown selection is typically preferred for a long list, check boxes were used to enable multiple

Question	Preferences explored	Phrasing logic
	available in New Zealand and incorporating Māori and Pacific groups). All Australian and New Zealand cultural and ethnic groups are listed. The list then narrows down to the specific ethnic groups. An 'other' option was added as per the suggestion of Pacific and Asian cultural advisors during the ethics approval process.	responses (Couper, 2008). This allowed participants to select the ethnicity groups they personally related to.
Education; Bachelor's degree in nutrition science or similar	It has found that university-education athletes score better in nutrition knowledge than non-tertiary educated athletes (Tam et al., 2021; Trakman et al., 2016). Therefore, the preferences of athletes with more experience as learners in higher education in nutrition sciences, versus those without higher education, is likely to differ (Shifflett et al., 2002).	In question display logic was used to identify the participant's experiences in nutrition sciences education.
Living arrangements; Food purchasing and preparation	Food planning skills is a noted barrier in elite British athletes; however, this may not be relevant to all athletes depending on their living situation (Bentley et al., 2021). The athlete's current living situation is also likely to determine the amount of influence they have from people they are living with. For example, younger athletes	Single choice multiple choice question.

Question	Preferences explored	Phrasing logic
	are more likely to receive information from their friends and family that will likely influence their food choices (Wiens et al., 2014).	
Special dietary requirements	Feedback from pre-testing suggested this question should be included, as those with e.g., celiac disease or type one diabetes mellitus will have stricter dietary guidelines to follow and are likely to have had more engagement with health professionals about their dietary intake. They may also seek more nutrition information in their own time to further understand their unique requirements.	This question is a yes/no answer. Display logic allows an open answer question for those who answer 'yes'.
Primary sport	Different sports have different nutrition requirements e.g., endurance, team, or aesthetic sports. This is likely to influence the content in performance NE the athlete has had in the past and their preferences going forward.	Drop down lists are often used when presenting long lists and seem less daunting to the participant (Couper, 2008). However, this was not able to work as intended in the chosen software. Instead, the sports were listed alphabetically, with in question display logic to identify the event/class specific to the participant in their sport. It was important here to list rather than provide an open entry answer to avoid shorthand answers that may be

Question	Preferences explored	Phrasing logic
		unknown to researchers who are unfamiliar with some sports.
Level of competition; Years at level of competition	Though all athletes participating in this survey are at the elite level (i.e., competing at a national or international level), the time taken to achieve this level of competition may be different between sports (e.g. gymnasts may achieve it by 16 years and endurance or team sport athletes by mid-late thirties). Therefore, training age and experience is quantified with this question. Athletes with more years in their sport are likely to have had more exposure to performance NE (Renard et al., 2020). However, nutrition knowledge is not consistently seen to be superior in elite compared to non-elite athletes (Andrews & Itsiopoulos, 2016; Cupisti et al., 2002; Murphy & O'Reilly, 2021; Renard et al., 2020; Spendlove et al., 2012). Elite athletes more likely to consume supplements at a higher dose and frequency than sub-elite athletes, which	These are written as item-specific response questions in absolute frequencies.

Question	Preferences explored	Phrasing logic
	may influence curricular topic preferences (Doherty et al., 2021).	

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Appendix C

Information sheet



The elite athletes' preferences for performance nutrition education.

INFORMATION SHEET

Researcher introduction

My name is Hayley Jenkins, a Master of Science in Nutrition and Dietetics student at Massey University's School of Sport, Exercise and Nutrition (SSEN). My primary supervisor is Dr Kathryn Beck, a New Zealand Registered Dietitian and Associate Professor in Nutrition and Dietetics in the SSEN at Massey University. My co-supervisors include Dr Claire Badenhorst (SSEN, Massey University) and co-investigators from Australia are Dr Gary Slater (University of Sunshine Coast, National Performance Nutrition Network Lead, Australian Institute of Sport) and Dr Janelle Gifford (The University of Sydney).

We are investigating what athletes would like in a performance nutrition education programme. From this information, we aim to develop a performance nutrition education framework to ensure nutrition information is provided to athletes in the most effective way possible. We invite you to take part in this online survey to help us further understand athlete preference for nutrition education.

Why is this research important?

Performance during competition is the primary goal for any elite level athlete. To perform at the level of intensity required by an elite athlete, the body requires constant fuel to support power, strength and endurance. Optimising nutrition can mean improved physical performance, cognitive function, and fewer days off training due to poor immunity or injury management.

There is currently limited evidence to tell us how athletes wish to receive their nutrition education. By choosing to take part in this survey you will share your opinions and experiences on nutrition education. This will help us understand how athletes think a performance nutrition education programme should be delivered. This provides you with the opportunity to shape future nutrition education interventions for athletes by high performance institutes, nutritionists and dietitians.

Who are we inviting to participate?

We are looking for at least 300 athletes to participate in this research project to ensure a wide variety of views are considered.

To participate you should be both:

- Sixteen years of age or older
- Competing in your primary sport at a national or international level.

You would like to participate, what will you need to do?

We will ask you to complete an online anonymous survey regarding your preferences for nutrition education. This will take approximately 15-20 minutes to complete.

What will happen with the information you provide?

All information collected during this study will be confidential and will be used only for the purposes of this research. To protect your privacy, your real name will not be used anywhere. The link directing you to the online survey is anonymous. Your email address, location data and IP address will not be collected when you select the survey link. As this is an online only survey, results will be stored in a password protected account with restricted access to members of the research team only. We do acknowledge there is a small possibility of re-identification through demographic information (i.e. age, gender, sport, ethnicity), however all attempts will be made to assure anonymity.

After completion of the data collection, the study findings will be written up as part of Hayley's Master of Science Nutrition and Dietetics thesis project. A summary of research results will be available upon request. Results of this project may also be published or presented at conferences or seminars. No individual will be able to be identified.

Participant's rights:

Completion and return of the questionnaire implies consent. You have the right to decline to answer any question.

Project Contacts

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

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Committee Approval Statement

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 21/38. If you have any concerns about the conduct of this research, please contact A/Prof Fiona Te Momo, Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800, x 43347, email humanethicsnorth@massey.ac.nz.

Thank you for considering participating in this study

Appendix D

Survey changes record

Online survey published 2nd September 2021

Sunday 5th September 2021

Fixed branching error when participant selected “Australia or Other” country, to ensure demographic questions were opened up to the participant.

This error affected 5 entries.

Thursday 9th September

NZ team meeting – edited matrix table (Q5.4) to change to “check all that apply”. In response to 10 participants leaving the survey at this question.

Thursday 16th September

NZ team meeting re possible ways to further reduce participant burden.

- *Deleted Q7.6: In addition to the main nutrition education programme, please rank your preferred delivery method for **performance nutrition support** - 1 being your most preferred*
- *Q9.2: The statement “different topics” was removed with the following reasoning:*
 - *Different topics is a redundant question – it is not beneficial in an education programme to learn the same topics every time.*
 - *To know that people want to be able to repeat topics to understand concepts (because that is their learning style), then in designing the NEP it can be understood that time needs to be allowed for this. Therefore, the statement “repetition of topics” was left as it.*
- *Q9.5: Deleted statements:*
 - *Monitoring of food diaries/dietary intake by the facilitator*
 - *Monitoring of body composition (e.g., percent body fat) by the facilitator*
- *Deleted Q7.18 Mixed Methods matrix table:*
 - *This was already a long section, and a potential pain point for repetition. Furthermore, with questions already asked on ‘in person’ and ‘online’ settings previously, and that there are many different mixed method modalities that have been used in NEP interventions throughout the literature (e.g., example lecture plus a handout, lectures plus an individual consultation, and finally technology-based), this question was considered not broad enough to offer enough worthwhile information to the research question.*
- *Edit ranked questions on online format (Q7.12) and facilitator credibility (Q8.6) from ‘drag and drop’ to “rank top 3” with ‘rank order radio buttons’.*

Appendix E

Open ended responses to survey question

If you could describe your ideal nutrition education programme what would it be?

I personally like the idea of one-on-one work. Nutrition is so individual and food can have a lot of emotional attachment which I wouldn't be comfortable sharing with everyone.

I think that if an athlete has access to a nutritionist it is important that they feel comfortable with the nutritionist and should have the opportunity to work with a couple to see who works best with them.

There should be an objective to each session plus a chance to talk about individual work on's/ goals. For a younger athlete it might be starting with energy requirements and how much and which foods an athlete should be eating- then build in to other relevant areas from there. Relevant topics should be brought up again and again.

I like the idea of monthly or every second month catch ups. I think food diary's are an important tool to use, to form a base of what to work on.

Science + experience based and tested with the newest or best learning available. But make that all simple and relatively relatable

A longer/intensive course at the start of the season and then regular check ins throughout the year with reminders ect. Lots of meal ideas and training/ racing based nutrition advise

In person with same squad for most but some personalised as well.
Definitely someone with experience in sport themselves

The one I have at the moment is pretty spot on. I've been working with a sports nutritionist for 9 years and it's a needs based programme. I enjoy group sessions because of the discussions and what you can learn from the experiences of other athletes.

Meetings and discussions with a facilitator. Being given my own health and dietary plan and having meetings often to evaluate it.

I'd want someone to walk me through the ideal way to handle sports nutrition for competition off season and on season but also how to adapt to suit the individual. Face to face sessions walking through the data in detail and then online classes to follow up from take home activities.

Athletes working together with coaches and educated professionals to collaborate on what works for them. Ie. Sharing of ideas and knowledge

My ideal nutrition program takes into account how sports use nutrition in different ways throughout the season and how to tailor nutrition (relating to different dietary needs) to athletes. Also looking at the difference between men and woman and taking into consideration the menstrual cycle and monitoring this also. Another essential part would include information on how to use legal supplements in the most effective way to protect against injury (such as bone injury), illness as well as support the body its recovery.

Interactive, interesting and relates easily to real life / what athletes have readily available

If you could describe your ideal nutrition education programme what would it be?

Hands on , fun cooking classes , more practical, quizzes in teams , videos, hand outs , slide shows , a little talking , but more workshops with brain storming

Quarterly face to face work shops with 5-15 peers (similar competing age group and gender) from mixture of HP sports - optional due to time commitment. Which run for 30-60. Each work shop builds on each other with provider available for 1 on 1 advice between workshops. Workshops have hands on aspects, cooking ideas, supermarket and shopping advice, energy requirements

Private & single sex

I like to learn through podcasts and some videos.
Find that I can keep busy doing things and have it running in the background and just absorb heaps of information!

I personally don't like group sessions which involve nutrition only because of the judgemental side of things I've felt previously being a bigger girl. It would be nice to have only female sessions too and I'm not sure if this has anything to do with your research but the factor that your period has with nutrition would be something valuable to learn about. One on one sessions to me are the way to go with follow up emails and such with informative links and pages to self research more if you like. I would love an example daily / weekly meal plan with ideas and such to follow, plus the factor of how your training changes throughout and how your nutrition needs to change as this is something I have struggled with. I also would love to know more about fuelling pre race, the day before included. And then throughout. I like the idea of 1-2 one-on-one session per month and then a few follow up emails throughout the week. Most online based with easy to manage things but I feel in person is more relevant for giving information ect

Balanced

Up to date information from a registered professional who is actively looking for nutrition advantages. This person being able to effectively relay this information in a way that is user friendly

Small group sessions with sports nutritionists once a month

Something personalised for the individual for there sport and position specific requirements

1 on 1 sessions periodically approx monthly with goal setting

Group sessions with creative ideas for meals, and extra supplementary information every 3-4 months

Interesting videos or media put up on group chat for personal extra viewing if wanted by athletes every so often if found

A series of face to face or online workshops on various different components of nutrition where you finish the programs having specific detailed idea of what should work for your nutritional needs.

If you could describe your ideal nutrition education programme what would it be?

Small group sizes so you can have some individualised feedback/advice. A few 1 on 1 sessions because everyone has different nutrition understanding and different needs. Having some application exercises eg worksheets could be handy to start to understand our nutrition more and improve it. Also maybe having coaches involved a bit might help athletes become more comfortable talking to our coaches about our nutrition and so their aware of any worries or habits.

Being able to relate information for the specific sport that I compete in. Having my programme monitored and given feedback on my food diaries and performances. Being given new ideas for meal planning/ meals continuously throughout the program that fit with my criteria. Make sure the program is still fun and enjoyable, to keep it enjoyable the food has to be enjoyable. The facilitator needs to be engaging, understanding of circumstances and most importantly kind.

One that caters to the individual. I feel general, 'one size fits all' kind of information is easily available online and in school etc. What we need is advice and ideas that apply to my specific sport, gender, age and goals. To do this I think interaction and discussion between facilitator and athlete is very important. The program would first get an idea of the challenges and gaps in knowledge of the people in the group, then it would focus on information that is specific to the group.

No fads.
Science based.
As individual as possible.

Fun, just with runners and more focused on performance benefits.

Groups of athletes and coaches have an in person session every couple of months. In between, everyone works with the facilitator individually, recording and monitoring nutrition data. This can be discussed in an online support group.

individual catchups with a facilitator to discuss nutrition plans based on the work and training load based on the time in the season. with refreshers and further catchups as this changes eg Preseason, competition, recovery, off season

Class based workshops or interactive environments where the participants can do the majority of their learning "Hands on" Occasional follow-up sessions one on one with the teacher/facilitator would also help to ingrain the newly learnt information into the participants memory.

Engaging teaches me everything I need to know to perform at best

Small group or one-on-one sessions with a registered sports dietitian with experience in my sport. Effective tips, less than 1 hour with realistic crucial information and practical ideas of what is best to eat at different times.

One on one based programme with a nutritionist who gives me a range of recipes that I can follow. Deciding what to cook is the most admin thing about nutrition in sport.

Incorporated into my current training program with my team mates and including hands on activities to make it enjoyable. Secondly having regular one on one meetings about my own personal nutrition with a nutritionist

If you could describe your ideal nutrition education programme what would it be?

Around 1-5, 45 minute lectures on different parts of my sport nutrition e.g one session on training nutrition, another on race day nutrition, and another on recovery nutrition

A few half hour sessions every few weeks

Full time nutritional assistance from a nutrition specialist..

One that is engaging and sport specific as it is more relevant for the audience.

Seminars throughout the year in person, in group and collaboration

One which promotes athletes to eat for performance not for weight/BMI/skinfolds.

Related to fueling the body for a female high-performance athlete.

Not calorie-count based or restrictive.

Respectful of the fact there are many pressures around food and body-image for athletes.

Giving a good idea over how to fuel my body for performance, training and recovery.

Some monitoring of food diaries, looking at areas to improve, general learning about concepts and how an athletes diet should look and how to find time to eat well.

Balanced

Nope too hard to write down here.

I would like to work with a facilitator who is a past athlete with real world experience, ideally in motorsport. The programme needs to be interesting and engaging throughout. Information needs to be clearly conveyed.

Occasional "courses" on topics group of athletes are struggling on or need advice on and then planning ideas and what to do to improve. These occur throughout the year

Knowing how much, what and when to eat/consume.

If you could describe your ideal nutrition education programme what would it be?

1 on 1 session with exercise physiologist/ dietitian etc

Sessions at start of preseason, beginning of season, mid season, finals and off season.

Include body measurements, sync with my Fitbit stats and training programme.

Look at my body composition and my metabolism and tell me what nutrition I need for the different phases in my season/off season relative to my goals.

Monitor, check in. Provide a variety of recipes.

UNDERSTAND THAT IM NOT JUST AN ATHLETE and adapt a programme around other elements of my life too like working a full time job and needing to have quick solutions sometimes.

:)

Clarity of information so that it comes to mind at critical moments - in the grocery store, searching for ingredients to cook etc.

A mixture of in person and online sessions - having one on one sessions to make individual plans for nutrition and tracking of progress/changes made. Other session with a group for overall education of nutrition e.g. energy requirements in relation to engird systems etc.

One on one program catering to my specific goals

A mix of in person and online sessions, with fellow athletes, the same age, that require the same, or similar information based on their discipline.

An overview of elite nutrition required for a power endurance sport. Then further discussions in later session about personal alterations/ needs to aid nutrition further

Informative interactive effective open including demonstrations like actual cooking and lots of images, stories, real life examples and work sheets, idealy in person

open, just females together, and one on one sessions

A mixture of on person one on one and group sessions where I work closely with one person to develop and monitor my nutrition

Fun enjoyable teaching environment

A continuous, year round programme which involves a variety of teaching methods, and that has no funding limitations so people can make the most out of expert advice.

Mostly one on one with sport specific workshops

If you could describe your ideal nutrition education programme what would it be?

Programme would be customised based on my training and competition requirements and schedules. Facilitator to keep me accountable. Open feedback loop after training and / or events to discuss what did and / or didn't work well. App or handy guides for nutrition to use when out for meals or buying food at the supermarket.

A fun, interactive programme that is designed for all athletes no matter what sport they compete in. I believe it would be great to have different types of education programmes for different age brackets so that younger athletes are not bombarded with information overload from a young age, whilst older and more serious athletes have the option to do more extensive courses. Furthermore, the ideal programme would consist of group sessions between males and females to cover nutrition basics, but then there would be the need to split and focus on different gender requirements for nutrition specifics. The education programme should be accessible to people that can start it at any point during the year rather than starting say at the beginning of each year. Finally, it should be designed that national federations within NZ endorse the programme and outsource from their own federations to use the programme. From my personal experience within Cycling New Zealand, there was no such focus on nutrition at a young age (U17-U19 categories). Furthermore, they have no programme in place for U23 athletes. They would only have a system in place for their carded track athletes.

Something as simple as possible. Time poor athletes will invest in it if its simple and not overly time consuming. Everyone agrees its incredibly important but if the delivery is just the basics and builds as you get athlete buy in it would be far more digestible

Something that is regular, relevant and engaging. Ideally one session per month that covers something slightly different, with meal ideas, tips and tricks

- Preparation and recovery
- Eating enough for your energy needs
- During training and race consumption
- Discussion of dietary supplements

with friends in a local setting, such as talks at your training location, lots of information and help as to what you should be aiming to eat to get best results out of training AND competition

Something to help let me know I'm doing the right thing, and guide me on the right path to get the best nutrition for my sport

A realistic approach to challenge to my current diet, that not only works around training and racing but work aswell

Delivers good knowledge on how the body uses energy. Delivers practical tips on how to nourish the body efficiently. Empowers the athlete with the understanding necessary to have clarity regarding the most important step they can take to improve.

Group of people all learning about something they're interested in

Teaching teens what food groups we should be eating to help us perform highly at training and competitions. As well as what foods and drinks are crucial for a good recovery.

If you could describe your ideal nutrition education programme what would it be?

I am not sure

Simple and easy to learn from

Dispel myths - especially around carb consumption / intermittent fasting / High fat low carb

Be tailored to me and adaptable for high and low training loads

I am also an athlete who has left sports for a number of years and returned, and more education around post-sport would have been invaluable. Myself, and many of my former teammates have experienced very poor relationships with food following retirement.

Access to a qualified nutritionist who specialises in my sport. Available one on one sessions, and group workshops every month on different aspects of sport nutrition.

Allows me to have a more in-depth understanding of the nutrients my body needs during off-season and competition season.

An educator who motivates. A bi-monthly session to remind that is live, interactive and has discussion. If attendance is difficult, then recorded. Some homework to keep engaged during the away period. Learnings and discoveries about nutrition that change habits and beliefs.

Consistent feedback, credible resource and knowledge shared by the facilitator to accurately and effectively be able to carry out this programme in my own life. Program relating and working with my training program to optimise my performance during and off season. Working with any circumstances that arise.

Occasional, informative, helps you maintain practices.

A one or two time in person session looking at the purpose of good nutrition with group activities looking at a range of nutrition for athletes. Have information that can be easily applied to each individual and their lifestyles. There should be a handout, email with summarised and important information from the session.

Having someone who ideally know about the sport & what is actually available and easy to access for people no matter what their situation is. I think I would be great to have a small block for a week then have regular catch up's and discussions so that it could actually sink in.

In-person group sessions with similarly experienced athletes, taught by recognised sports nutritionists or dietitians(who has previously worked with my sports).

Delivering once every month or two months. With interesting and credible topics.

Plain English advice and information regarding the best nutrition for me in my sport, preferably with easy recipes for meals and snacks.

Someone willing to help constantly and are available to answer questions.

Group sessions, workshops, activities, videos you can watch back if you forget something (content related to the session completed)

If you could describe your ideal nutrition education programme what would it be?

Closely monitored by a registered sports dietician/with experience in my specific sport throughout preseason to in-season

1 one 1 or small groups

For me, the ideal nutrition education programme would cater to my nutritional needs.

Sport: ROWING

Gender: female

For example

-I struggle with my maintaining my weight during peak season and are often confused how to correctly fuel myself

-I often suffer from extreme fatigue and would like to know how to minimise this

-I would like to understand how my body type/BMI impacts my nutrition (I'm quite slim and struggle to gain needed weight for intense season)