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A Review of Factors Influencing Athletes' Food Choices

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Key Points

- There are few studies exploring factors influencing athletes' food choices, yet the demands of many sports require high energy intake.
- There is some evidence to suggest food choices are influenced by factors specific to sport, such as performance.
- Food choice is dynamic, complex and continually changing and more research is needed with athlete populations where food choices are likely influenced by the demands of sport.

Abstract

Athletes make food choices on a daily basis that can affect both health and performance. A well planned nutrition strategy that includes the careful timing and selection of appropriate foods and fluids helps to maximize training adaptations and, thus, should be an integral part of the athlete's training program. Factors that motivate food selection include taste, convenience, nutrition knowledge and beliefs. Food choice is also influenced by physiological, social, psychological and economic factors and varies both within and between individuals and populations.

This review highlights the multidimensional nature of food choice and the depth of previous research investigating eating behaviours. Despite numerous studies with general populations, little exploration has been carried out with athletes, yet the energy demands of sport typically require individuals to make more frequent and/or appropriate food choices. While factors that are important to general populations also apply to athletes, it seems likely, given the competitive demands of sport, that performance would be an important factor influencing food choice. It is unclear if athletes place the same degree of importance on these factors or how this is influenced by involvement in sport. There is a clear need for further research exploring the food choice motives of athletes, preferably in conjunction with research investigating dietary intake to establish if intent translates into practice.

1. Introduction

It is estimated that individuals make food choice decisions approximately 220 times a day [1] and these are influenced by a multitude of both external and internal factors [2]. A number of approaches have been used to explain the processes and motivations behind food choice [3-6] and many have been used to explain the eating choices of various populations, including athletes [7, 8].

Food choice is known to be influenced by many factors, including taste, convenience, price, and cultural and/or religious beliefs [2, 6]. The literature also reports a strong influence of food availability and security [9]. In addition to these factors, individual knowledge about food and nutrition as well as personal and/or family beliefs are also known to influence food choice [10, 11]. Amongst athletes, involvement in sport and the recognized importance of food and nutrition on sports performance is also likely to play an important role [7, 8, 12, 13]. Furthermore, it is probable athletes are influenced by coaches, the behaviours and practices of other athletes and the culture within sport [8, 14]. Concerns about weight and body image are strong influences on food choice for general populations [15] and have similar effects on athletes where attempts to achieve physique and body weight goals for performance and/or aesthetic reasons contribute added pressure [16, 17]. Additionally, the influence of the media and social facilitation can have a strong influence on the food choices of both athlete and general populations [18-20]. Factors important in food choice may differ based on the athlete's priorities, as sport

participants can range from the recreational (leisure or amateur sport) to the elite (compete at the national or international level) [21, 22]. However, despite a large body of research with general populations, there are few studies examining this issue amongst athletes. This review explores the factors that influence food choice and eating behaviours with an emphasis on issues unique to sport. As the research is limited, athletes from the recreational to elite level are included, along with differences that may exist between these groups. The multidimensional nature of food choice is highlighted along with the limited understanding of this area within athlete populations.

2. Approaches to understanding factors influencing food choice

Numerous approaches have been used to describe individual behaviours in relation to food choice and dietary intake [4, 6, 23, 24]. Furst et al., [6] describe the food choice process, a model that incorporates the influence of past experiences, individual ideals (e.g. expectations and beliefs), personal factors (e.g. food preferences and health status) and resources (e.g. skills and knowledge) on food choice. These components help to shape an individual's 'personal food system' which is used to make a final food decision [6]. The food choice process has been used to explain the eating behaviours of older adults, families and a small number of athletes [7, 8, 25, 26]. Other approaches provide different perspectives to understanding why people select foods and include factors such as, the environment, social influences, personal beliefs and skills [10, 23, 24]. For example, eating decisions have been described as dependent on the environment, location or situation in which the food choice is being made [24, 27]. This may include what is available and whether the individual is alone or in the presence of others, which can influence the amount and type of food consumed [28, 29]. In social situations where meals are eaten with others, both athletes and non-athletes report food choices are often influenced by what teammates or peers chose to eat [7, 11].

Personal identity or self-image may be a factor in food choice [30, 31]. Individuals may describe themselves as a certain type of eater, such as 'not a breakfast eater' or 'meat and potatoes guy' [31]. They may have multiple identities with some more important at certain times than others [31]. Many individuals identify with an athlete role where participating in sport provides a strong sense of self [32]. This is observed at all levels, but greatest in elite athletes and males [32]. As such, many decisions are made, which can include food choices, that support their role as an athlete [33].

Confidence in food management skills, including the ability to prepare, purchase and buy food, may influence food choice [23]. For some, life and past experiences can determine what foods are eaten as cooking skills learnt at an early age may help with decision making [23]. In contrast, many young athletes, faced with limited cooking skills, are challenged when they move away from home where meals were often provided by parents [34].

Factors important in individual food choice have been investigated using quantitative tools, such as the Food Choice Questionnaire (FCQ) [35]. Designed to address the importance of several factors (e.g. health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity and ethical concern), this approach has been used to measure the food choice motives of various populations, including consumers from around the world [36, 37]. This approach has also been used to study the food choice motives of adolescents, dental students

and the motives behind organic food choices, however, it has not been used on athlete populations [38-40]. Overall, a greater understanding of the various approaches used to study food choice behaviours is important when investigating the factors that influence the food choices of athletes.

3. Determinants of food choice

3.1 Physiological and biological

3.1.1 Hunger and appetite

Historically, the primary factor believed to influence individual food choice was to satisfy biological hunger typically driven by appetite and satiety [41]. Indeed, hunger is a factor that can motivate individual food choice [6] and may override the importance of preference [42] and price [6] particularly the more food deprived an individual becomes. Under these circumstances, research reports the immediate availability of food is more important than taste to the food deprived individual [42]. Exercise may increase the appetite of athletes and, therefore, it is possible this may be a bigger driving force to eat amongst this population [8].

A large body of research with non-athletes (both active and sedentary) reports a temporary suppression of appetite following moderate to intense exercise, often referred to as exercise induced anorexia [43-46]. This may be related to changes in appetite regulatory hormones, body temperature, and/or reduced blood flow to the gut [45, 47, 48]. However, appetite suppression is not always evident with differences likely the result of variations in study design, particularly regarding the intensity, duration and type of exercise [45, 49]. Furthermore, the effect of exercise on appetite suppression may vary based on sex and environmental conditions [50, 51]. In a group of sedentary, overweight/obese individuals, females reported no difference in hunger ratings following exercise of moderate intensity (50-65% VO_{2max}) while males reported decreased hunger and less desire to eat [51]. Appetite is suppressed at higher altitudes [50] and during exercise in hot environments [47]. In contrast, although hunger was not assessed, research suggests exercise in colder temperatures may stimulate appetite based on increased energy intakes [52]. Athletes train and compete in a range of environments and a greater understanding in this area could assist the nutrition practitioner in catering and planning meals for athletes attending training camps under various conditions.

Despite a wealth of research exploring the impact of exercise on hunger and appetite is it still unclear how this influences energy balance and the regulation of body weight [49, 53-55]. Considering the typically higher energy expenditures of athletes [56] it might be reasonable that hunger may have a greater impact on food choice in this group. However, very few studies have explored this effect in athletes or how this influences dietary intake. In fact, studies exploring the relationship between hunger, appetite regulatory hormones and dietary intake have not been consistent [49, 53] with some showing a poor coupling between these variables [57]. In healthy non-athletic males there was no difference in energy or macronutrient intake despite variations in hunger ratings and appetite regulating hormones when endurance (60 minutes continuous cycling at 65% VO_{2max}) versus sprint interval (6 x 30 second Wingate tests) exercise was performed [49]. Research shows athletes may eat despite a loss of appetite [13] or may ignore hunger cues and restrict intake in order to meet weight goals [58]. These behaviours appear to conflict with the appetite suppressive effects of exercise and suggest hunger may not be a

primary motivator behind food choice. In fact, relying on hunger as an indicator of an athlete's energy needs may not be appropriate when working with this population [59].

3.1.2 Macronutrient balance

It has been proposed that homeostatic mechanisms associated with fat, carbohydrate and protein balance help regulate eating behaviour and energy balance [60-63]. For example, the lipostatic theory suggests signals that arise from adipose tissue regulate energy intake when fat stores are challenged, such as during energy restriction [63]. Likewise, imbalances in carbohydrate or protein (i.e. low carbohydrate, low protein or low calorie diets) may stimulate regulatory signals that lead to eating in order to restore macronutrient balance [61, 64]. Furthermore, depending on the extent of protein or carbohydrate deprivation, attempts to restore balance may lead to overeating if foods selected are low in the macronutrient that is out of balance [61, 64].

The glycogenostatic theory proposes depleted glycogen levels drive food intake behaviour in order to restore carbohydrate balance [62]. Low carbohydrate availability should reduce glycogen stores and generate a net negative carbohydrate balance, thereby leading to increased eating until carbohydrate availability is restored [65, 66]. The protein leverage hypothesis suggests if diet patterns shift to favour lower protein foods (i.e. percent protein of the diet drops below dietary requirements) this may act as a signal driving increased energy intakes in order to restore protein balance [61, 67, 68]. However, short intervention studies exploring the glycogenostatic theory have reported either increased, decreased or no change in energy or macronutrient intake during a period of ad libitum eating [69-74]. Greater energy and macronutrient intakes post exercise may be related to substrate oxidization [75]. High carbohydrate oxidizers (who potentially rely more heavily on glycogen stores) may be more likely to eat in the post exercise period in order to restore carbohydrate balance. However, this is not universally seen in research investigations, with differences potentially relating to experimental design and the population group being studied [75-77]. In studies that included an exercise protocol, the consumption of carbohydrate during exercise may have played a role [75, 76]. Instead of substrate oxidation driving eating behaviours, it is possible when participants consumed carbohydrate during exercise, glycogen stores remained stable and the post exercise drive to eat was reduced [78]. Finally, these findings may differ due to length of the post intervention assessment period (i.e. 4 versus 24 hours), exercise protocol (i.e. moderate to intense), duration (i.e. long versus short) and sample size [70, 71, 73, 77, 79].

There is also some support for the protein leverage hypothesis when subjects had greater energy intakes after four days on a low protein diet (< 15 % of energy) [67]. Energy intake decreased in subjects who followed a high (30%) versus a low (5-15%) protein diet for 12 days [68]. However, those on the high protein diet were in a negative energy balance with reduced intake occurring mostly at meals [68], while those following the low protein diet ate more snacks between meals. Both of these studies also showed reduced hunger ratings and, therefore, differences in energy intake could be related to the role of protein in satiety [80, 81]. Furthermore, when protein balance is challenged due to suboptimal intake, it is possible the body will adapt with an increased preference for protein rich foods in order to restore balance without increasing energy intake [82]. Given that many athletes fall short on the appropriate distribution of protein across the day [83, 84], and the protein needs of athletes are higher [12], the protein leverage concept may play an even greater role amongst individuals with active lifestyles.

Much of the literature surrounding macronutrient specific regulatory systems relates to energy intake and obesity [61, 85-87] and it is possible these theories apply differently to athlete populations where it is common practice to consume carbohydrate during exercise and training adaptations may alter substrate utilization [88, 89].

3.1.3 Fat free mass, resting metabolic rate and hunger

Studies exploring the relationship between hunger and dietary intake typically focus on appetite regulatory hormones associated with adipose tissue and the gastrointestinal tract [49, 90, 91]. However, recent research suggests fat free mass (FFM) and resting metabolic rate (RMR) may play an important role [92-95]. One of the largest contributors to RMR is FFM [96] and this may be a factor driving food intake in both overweight individuals and athletes who typically have greater absolute amounts of FFM [12, 95, 97]. It is possible the higher FFM may influence food choice by acting as a physiological signal that stimulates appetite and subsequent eating behaviour. Consequently, there is a need to investigate the potential role of RMR and FFM on hunger and dietary intake and how this may differ amongst athletes, especially considering the body composition of athletes can vary both within and across sports and over a competitive season [7, 59].

Overall, the role of hunger, macronutrients, fat free mass and metabolic rate on food choice in both athlete and general populations remains unclear. It is possible the influence of these factors may differ in athletes as a result of physiological and psychological adaptations that include an increased sensitivity to satiety signals and/or an improved ability to regulate energy balance [98-100].

3.1.4 Taste and food preferences

Taste is an important determinant of food choice across different age groups and cultures [101-103]. This is not surprising as the aroma, taste, texture and appearance of food provides pleasure and enjoyment making for a rich and varied sensory experience [104]. In the absence of economic and availability issues, sensory appeal is thought to be the most important determinant of individual food choice [105]. If a food does not appeal to the senses, regardless of price, availability or nutrient content, it is unlikely to be eaten [105]. However, the importance of taste can differ based on sex, income and age and is often considered with other priorities, such as health, weight or financial concerns [2, 6]. Individuals living with chronic disease may emphasize health over taste when they avoid favourite nutrient poor foods in favour of those they believe are healthier [2]. Likewise, weight conscious individuals will prioritise low energy foods that support their body composition goals over more palatable choices [106]. Those with lower incomes will balance taste over cost when making food choices [6]. The influence of taste can differ between individuals and groups, such as in family settings when meals can be determined by food preferences of the whole family [107]. Although weight goals are a concern for many athletes, the sensory aspects of food remain important to many [7, 108]. However, amongst athletes, taste may become less critical prior to an important game or event when foods that benefit performance are preferred [7, 33]. Some athletes avoid preferred foods before competition in order to meet weight specific goals [58]. Overall, taste has a strong influence on food choice, but importance likely varies with eating occasion; how this applies to athletes or influences performance goals is unknown.

3.1.5 Gastrointestinal discomfort

Individuals with food allergies or intolerances will avoid certain foods to reduce the risk of an allergic reaction or minimize discomforts, such as gastrointestinal (GI) upset [109, 110]. The food choices of athletes can also be influenced by GI issues that are not due to health or disease concerns, but are unique to sport. A common complaint for many endurance athletes includes intestinal discomforts such as heartburn, bloating, diarrhea, cramps, nausea and vomiting while exercising [111-113]. Depending on the severity of GI upset, this may impact performance and overall race outcome. Consequently, experience with GI issues may influence food choice not only during, but leading up to, an event. Studies report athletes will change their eating patterns and food choices prior to a race in order to avoid GI discomfort [13, 111]. Athletes appear to learn from experience and through a process of trial and error adopt nutrition strategies that work for them [13, 111].

3.2 Lifestyle, beliefs and knowledge

3.2.1 Lifestyle and motives for participating in sport

Factors important in food choice can vary depending on the ideals or lifestyle preferences of an individual or group [5, 101, 114, 115]. For example, individuals grouped according to lifestyle range from the "rational" consumer more interested in food preparation and nutrition to the "conservative or uninvolved" consumer who places more importance on convenience [116]. The health conscious consumer often places greater importance on exercise, nutrition and weight control [101]. Consumers who place greater importance on health and nutrition, often include more females, older adults and those with higher incomes and education levels [15, 117]. Individuals may participate in sport as a way to become physically active and this may be motivated by health or weight loss reasons [118]. Likewise, motives for participating in sport also include competition [119, 120]. The limited number of studies with athletes report performance or competition is one of the most important influences on food choice for both individual and team sports [7, 8, 13, 108]. Furthermore, the importance athletes place on food choice may vary with the phase of the season, the type of sport and competitive level [7, 13, 108]. For example, hockey players are more relaxed about food choices during the off season when performance is not critical, and more competitive triathletes tend to favour foods that maximize performance. Athletes involved in power or skill based sports place less importance on factors that influence performance (such as the nutrient content of foods) than those in endurance sports [108]. This may relate to a belief that nutrition plays a minor role for those involved in these sports. When exploring food choice motives these issues must be considered as importance may vary depending on the level, training period and type of sport in which an athlete participates.

There are many other reasons people take part in sport, including friendship, stress release and personal gratification [33, 119, 120]. These individuals range in age, fitness levels and personal backgrounds and their motives for food choice may differ to the elite athlete who competes at an international level [120, 121]. Motives for participating in sport may influence the importance placed on food choice as personal goals may differ from an athlete with physique goals to another who enjoys the freedom of eating whatever they desire [21, 120]. Although research is scarce, the motivation to participate in sport may be based on a lifestyle choice that influences food choice. This is important to consider when working with athletes as some may not be open to nutrition advice if changes to a meal plan interfere with other factors they identify as important.

3.2.2 Health Beliefs

Health is an important factor in food choice for many individuals and is often associated with better dietary habits [15, 122]. For example, individuals who value health report greater intakes of fruits, vegetables and fibre [101]. These individuals also tend to make similar healthy lifestyle choices by not smoking and engaging in more physical activity. The importance of health is influenced by age, sex, education, nutrition knowledge and physical activity level [123]. Studies report males, younger individuals and those with lower incomes place less importance on the value of health [37]. However, this can be influenced by nutrition knowledge with research showing younger individuals with greater knowledge value healthy eating and engage in more physical activity than their less active peers [124]. Furthermore, health can have different meanings for people and for the athlete may include feeling well for their sport and having a lean, athletic appearance, while for others it entails avoiding unhealthy habits, such as smoking and drinking [7, 120]. Overall, it is unknown if the reported link observed in general populations between physical activity, healthy eating and the importance of health also applies to athletes as their exercise motives may be performance rather than health orientated. It remains to be investigated if the higher physical activity level of athletes means they place high importance on health when selecting foods.

3.2.3 Nutrition knowledge

Nutrition knowledge and beliefs can influence food choice [6]. Knowledge is described as both an awareness of nutrition as well as the ability to practically apply this when choosing healthy foods [10]. As such, the athlete's knowledge about nutrition, both general and sport specific, may impact their food choices and subsequent dietary intake. Likewise, their beliefs about nutrition and level of knowledge may determine the importance placed on food choices as influenced by the athlete's understanding of the role of nutrition on health and sport performance. Nutrition education is often used to help change human behaviours and is provided with the expectation that greater knowledge will lead to improved dietary practices and better food choices [125]. Research has shown an increase in fruit and vegetable consumption in adults with improved knowledge [126] and that college students with greater awareness of nutrition guidelines eat healthier [127]. The health and sport specific nutrition knowledge of athletes is not well understood and there is only weak evidence supporting a link between greater knowledge and healthier food choices [128, 129]. Furthermore, despite an awareness of sport nutrition, athletes do not always put knowledge into practice [130]. Athletes of higher calibre (international versus national level) have been reported to have a greater level of nutrition knowledge, which may influence the importance placed on food choice [131]. However, despite greater knowledge, elite athletes, who compete internationally, may place performance above all else when making food choices [132]. Although limited research suggests the dietary intake of athletes may be influenced by nutrition knowledge, further investigation is needed that also takes into consideration additional factors that may be important in the athlete's food choices.

3.3 Psychological

3.3.1 Body image and weight control

Research reports weight is an important factor in food choice, particularly for those concerned with body shape and size [35]. Cognitive dietary restraint is referred to as the conscious restriction of food intake in order to control body weight [133]. This may include 'diet rules' such as choosing products low in fat and calories or

restricting selected food groups [134, 135]. Dietary restraint has been researched extensively in non-athlete populations, particularly in the areas of weight loss, dieting and disordered eating [18, 118, 135-138]. Similarly, amongst athlete populations dietary restraint has been explored in relation to disordered eating, bone health and ovulatory disturbances [16, 139, 140]. Many athletes attempt to modify body weight and composition believing this will enhance performance [97]. Likewise, many athletes are susceptible to pressures to modify body composition to achieve a lean, athletic look [7], particularly in sports where leanness and low body mass are emphasized [12, 16]. In sports where body weight and shape receive greater attention, such as gymnastics and swimming, both male and female athletes are at increased risk for disordered eating [17, 141]. Hence, these issues can be factors influencing food choice as athletes restrict food intake to meet weight goals for aesthetic or performance reasons. Given that body mass and physique have been shown to influence performance outcomes in sport [142, 143], physique goals may influence the food choices of athletes. Overall, weight concerns may be a driving force influencing the food choices of many athletes and future research exploring this area is needed. It is possible, even within these sports, weight concerns are influenced by competitive level and personal goals.

3.3.2 Hedonic Hunger

The growing worldwide epidemic of obesity and chronic disease demonstrates people eat for reasons beyond satisfying hunger [18, 41, 144]. Opportunities to consume a plethora of palatable, easily accessible and, for the most part, inexpensive food choices, continue to grow. It is for this reason many argue that food choices today are largely influenced by what is referred to as hedonic hunger, where individuals have an 'appetite' for the pleasurable tastes of food [41]. Research exploring hedonic hunger reports differences, following exercise, between compensators and non-compensators [145]. Compensators are described as those who make up for the energy cost of exercise with an increase in food intake, whereas non-compensators do not [145]. In addition to an increase in energy intake, compensators score higher on hedonic hunger than non-compensators and this may be associated with the belief that food is a reward for exercise. Amongst athletes, the influence of hedonic hunger may be influenced by sport specific motives. For example, it may be expected hedonic hunger would differ between the restrained athlete closely controlling body weight and the athlete who believes a benefit of training is being able to eat more food [120].

3.4 Social

3.4.1 Meal patterns, availability, social facilitation and marketing

What people eat can be driven by social influences associated with daily living, such as meal patterns [6, 24]. Hectic work and family schedules make convenient foods important in the lifestyles of many people, with preference placed on meals that are quick and easy to prepare [101, 146]. Due to the added pressures of study and school commitments, many young college students rely on store-bought, prepared foods and rate convenience as important in food choices [147]. A demanding training and competition schedule is common to many athletes, many of whom are responsible for purchasing, preparing and managing their dietary choices [8]. As such, athletes may adopt strategies that help them meet energy demands, which include planning ahead in order to have foods available after training or consuming frequent meals and snacks [7, 84, 148-150]. Athletes may value foods that are convenient and easy to prepare as suggested from research investigating triathletes whose eating patterns were

influenced by convenience as they managed a busy schedule [13]. Likewise, it is one of the reasons college athletes reported convenient food choices were important [7, 8]. Habits are behaviours that are repeated on a regular basis that help alleviate the need to make conscious and ongoing decisions about food choices [151]. For the athlete, regular routines, established to meet busy schedules, may become habitual and may allow decisions to be made with minimal thought involved [8]. As such, habits may also be a factor in the athlete's food choices.

Finally, food availability, social facilitation and marketing may influence food choice [20, 29, 30, 152, 153]. Today's eating environments offer limitless opportunities to consume food and evidence shows this can influence what and how much people eat [1, 28]. This includes social facilitation when people adjust their food choices by eating more (or less) food or make healthier choices in the presence of others [18, 29, 154]. This is seen with athletes who report over eating in dining halls due to the abundance of available options and/or from making second trips to the food line after observing teammates eating food that looked appealing [7, 8]. Similarly, the food choices of young athletes can be influenced by the eating choices of senior, more experienced teammates [8]. Food marketing and labelling as well as the media and advertising can influence food choice [19, 155]. For teenagers, food outlets, media, school and advertising can have a greater influence on food choice outside the home when parental control is reduced [146]. The media and advertising are a common source of nutrition information for many consumers, including athletes, and this may influence their food choices [34, 111, 155].

In summary, research demonstrates how meal patterns, availability, social facilitation and marketing can influence food choice. However, it is uncertain how important these factors are to athletes. Research with general populations show food choices made when convenience is a priority are of lower nutritional value [156] and it is possible this also occurs with athletes. However, it is unclear how the media, social facilitation or various eating environments influence the athlete's food choices and further research in this area is needed.

3.4.2 Culture and religion

Culture represents a shared set of values, characteristics, attitudes and beliefs that help guide the activities, decisions and behaviours of individuals [157]. Different cultural groups have a range of beliefs and practices and these can influence food choice [5, 158]. Customs and traditions within cultures are typically passed onto children and, therefore, transfer across generations [5]. Cross cultural differences and similarities in food choice motives have been reported with consumers from around the world [36]. Within cultures, individuals vary in the importance they place on consuming traditional foods based on other factors they find important. Those who value health or weight control may avoid certain ethnic cuisines viewing them as higher in calories [159]. Athletes from around the world come from a range of sporting, religious and cultural backgrounds and, as such, their food choices may be influenced by cultural beliefs, traditions and values [160, 161]. For some athletes, family traditions and ethnic background have little importance on food choice [8], whereas for others making food choices based on religious beliefs is of utmost importance [162]. The culture within sport may influence food choices where traditions and beliefs are strong and the value of nutrition may not be recognized [14]. Indeed, long held customs may override health and sport recommendations in favour of performance as seen in making weight sports, such as wrestling and horse racing [58, 163]. Overall, cultural influences are important determinants of food choice and may be an important factor to athletes.

3.5 Economic

3.5.1 Cost and income

Price can influence food choice due to financial constraints, particularly for lower income individuals, students and youth [101, 147]. Elite athletes on a limited budget report financial constraints interfere with making food choices that support a healthy diet [34]. Indeed, those at the elite or professional level, who train full time, report financial issues are a major stressor [164]. Likewise, budget friendly food choices are a priority to the college athlete responsible for purchasing their own foods [8]. However, many who take part in sport are employed full time and work professional jobs where financial concerns may not be an issue [165]. Indeed, participation in certain sports can be costly and therefore, attracts only those who can afford to take part [33]. For these sports, equipment, competition fees and a number of other expenses require a substantial monetary contribution [165]. In certain cases, income level is not always the driving force behind the importance of price in food choices. For many, obtaining good value for money is important, regardless of price [166]. Therefore, although research is limited, it is possible the importance athletes place on price may vary depending on income level and be associated with motives other than the bottom dollar.

4. Future directions and conclusions

The food choice motives of athletes have been explored in only a small number of studies and further research is needed across a range of sports, competitive levels and during different stages of a season. This should include a greater focus on the influence of culture, both within and outside sport, particularly in recognition of the growing number of participants in sport worldwide. More research exploring the nutrition knowledge, both health and sport specific, of athletes is needed, including how this relates to food choice motives and dietary intake. It is important to consider how taste, one of the strongest determinants of food choice, may differ amongst athletes and how this may change across sport and with athlete specific performance goals. The influence of appetite and hunger and the potential role of macronutrient balance in food choice requires further investigation, in particular related to the changing eating environments in which the athlete trains and competes. These include the non-homeostatic factors related to food environments, such as food marketing, along with restrained eating practices, which may override internal cues associated with appetite and hunger. Overall, in view of the unique environments in which the athlete makes food decisions and the impact of physical exercise on energy demands, the factors that influence the food choices of athletes is an area worthy of further investigation.

This review demonstrates the many physiological, social, psychological and economic factors influencing the food choices of both sedentary and athlete populations. Findings suggest factors important to the general population, such as taste, health and weight control are also important to athletes. However, despite the numerous factors known to influence food choice in general populations, it is difficult to say if and how these also apply to athletes. An athlete's calibre, type of sport or stage of training may also play a role. Furthermore, the pressures associated with body shape and size, common to many athletes, may also influence food choice. Appreciating the highly competitive world of sport and the demands faced by athletes to excel, it is possible performance also plays an important role in food choice, but this is expected to be influenced by a variety of other factors. Lastly, while this review highlights the multitude of factors that may influence food decisions, it is

important to remember that food choice is dynamic and importance may vary depending on the time, location and changing situations in which the athlete makes food choices.

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