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INTEGRATING SUSTAINABILITY IN ATHLETES' DIETARY CHOICES

SUSTDIET
GUIDELINES ON SUSTAINABLE DIETS FOR ATHLETES

KMGNE ANCE MEHFA Sport Evolution Alliance Mathaino Diatrofi Defoin

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SUMMARY

1. INTRODUCTION

Sustainability is a multifaceted issue, defined as "the needs of the present without compromising the ability of future generations to meet their own needs." (Imperatives, 1987). Therefore, achieving a healthy and sustainable life is crucial and depends on global collaborative efforts.

The guide "**Integrating sustainability in athletes' dietary choices**" is a result of the SustDiet project (2021-1-DE02-KA220-ADU-000033782) co-funded by the European Education and Culture Executive Agency (EACEA), which justifies and explains the importance of implementing more sustainable choices in athletes' diets, providing critical information and practical recommendations on how can athletes implement a more sustainable diet without compromising their athletic performance. It also considers the repercussions on the health of those professionals whose diets are important for athletes' personal and professional development.

The partners involved in the development of this guide [Kolleg fuer Management und Gestaltung nachhaltiger Entwicklung (KMGNE, Germany), Mathaino Diatrofi (Greece), Athens Network of Collaborating Experts (ANCE, Greece), Malta Exercise Health And Fitness Association (MEFHA, Malta), Sport Evolution Alliance (SEA, Portugal), Bolu provincial directorate of youth and sports (Turkey) and Formación para el Desarrollo y la Inserción (DEFOIN, Spain)] underwent several assignments to collect the adequate material to develop this document. An initial and extensive desk research was performed, concluding that although there is good evidence regarding sustainable nutrition, information is scarce regarding sports nutrition and sustainability. Afterwards, a questionnaire was developed and applied to understand the athletes' nutritional habits, as well as their knowledge regarding sustainable diets, including their willingness to improve their diet sustainability. A different questionnaire was applied to sports nutritionists and coaches to understand their knowledge regarding this topic and their willingness to change their athletes' diet into a more sustainable one.

The results of these questionnaires are presented by country in each national report (6 in total) and globally in a different document that will be referenced throughout this guide.
Thus, this guide aims to provide a foundation upon which sports professionals, as well as other professionals in the area, such as nutritionists/dietitians, trainers and coaches, broaden their knowledge on nutrition and sustainability to reduce the human footprint on the environment. In this way, it will be possible to establish a secure basis for sports professionals to change their eating habits while maintaining the levels of nutritional elements necessary to perform in the sports environment.

This guide is divided into **3 chapters**, namely:

1) **"What do we know about sustainability?",** an introductory chapter focusing on introducing the concept of sustainability. The role of nutrition in sustainability will also be discussed in this chapter, as well as the concept of a sustainable diet. Lastly, the role of athletes in this topic will also be addressed;
2) **"How can we increase sustainability in our dietary choices?"**, where the Mediterranean and the flexitarian diet will be described in detail, as well as strategies that should be implemented to increase sustainability in athletes' diets;
3) **The role of nutritionists/dietitians and coaches in increasing sustainability in the sports field.** This chapter describes the role of both professionals in guiding their athletes towards sustainable choices.

2. 1. WHAT DO WE KNOW ABOUT SUSTAINABILITY?

Sustainability is identified as the ability to exist and develop without depleting natural resources for the future; acquiring more sustainable choices will be beneficial in both the short- and long-term (TWI). In the last decades, the term sustainability has spread and gained importance in every sector of our society, economy, and environment. Indeed, thousands of political measures, speeches, company policies, and daily practices are directly or indirectly linked to the concept of sustainability.

The first testimonies regarding the term sustainability date back to the 18th century. Carles von Carlowitz was one of those who laid the foundations of what we understand by modern sustainability and sustainable development in his book *Sylvicultura Oeconomica* (Judith C. Enders, Theories of Sustainable Development, 2015). According to the book, the fundamental pillar of this theory is the need to find the balance between natural resources, their exploitation (by human activity), and their regeneration. In a few words, von Carlowitz proposed not to cultivate or harvest and use more natural resources than the Earth can produce/reproduce over a given period. Although rudimentary in terms of actuality and modernity, this imperative is the basis of current sustainable development theories. However, it is evident that perspectives on sustainability are to some extent flexible, diverse, and sometimes unreasonable, as it mainly depends on the authors' vision of development, their background and knowledge. Thus, it is not uncommon that, on the one hand, we can find some theorists that defend more science-based perspectives. On the other hand, we find others that bring it together in a rather politically-influenced manner.
For these reasons, it is necessary to adopt an interdisciplinary perspective to understand the concept of sustainability. This means that different science sectors ought to be combined and cooperate to truly capture the essence of sustainability.

Therefore, the different branches of knowledge of the economic, industrial, and scientific fields must join their efforts and work together to achieve the goal of protecting the natural world without compromising socio-economic development.

With the Club of Rome Report "Limits to Growth" (1972), the UN Brundtland Report (1987) and the UN World Conference in Rio de Janeiro (1992), the general perception of the negative consequences of the capitalistic system began to shift towards a new and necessary development paradigm. This desired path change was called sustainable development, which aims to shift our behaviour and mode of action to a less, more circular, long-lasting, regional and cooperative development system. As a result, nowadays, the concept of sustainability has been divided into three different pillars, which are interconnected: social, economic, and environmental.

Consequently, these pillars have been the groundwork for the 2020-2030 Agenda of the European Union and the Sustainable Development Goals (SDGs) of the United Nations. These measures have been one of the main catalysts that have led to the development of policies that materialise the reduction or mitigation of the effects of climate change in the short, medium, and long term.

2.1. The role of Nutrition in Sustainability

The World Resource Institute (2016) states that "we are what we eat, and what we eat has a profound impact on the planet", which underlines the importance of sustainable diets as a crucial part of sustainable development. The various negative impacts of current food systems on the environment are uncontested. Nutritional style does not only influence one's well-being and health, as the way food is produced. Where and how it is purchased also has a manifold impact on the environment and society. Today's food production creates over a quarter (26%) of anthropogenic greenhouse gas emissions, ~32% of global terrestrial acidification and ~78% of eutrophication, meaning freshwater pollution (Poore & Nemecek, 2018). The current agricultural system is furthermore in need of a high number of resources, showing an incredibly high water and land use (Poore & Nemecek, 2018). This intense use of resources is usually shown in large meat industries. Regarding the loss of biodiversity, food production is also a significant contributing factor. The immense anthropogenic influence on planetary systems is undeniable: 94% of non-human mammal biomass is livestock, and 71% of bird biomass is poultry livestock (Bar-On et al., 2018). Another main problem is the generation of waste, especially plastic waste, due to the large number of products that are packaged in single-use plastic containers and end up mainly in seas and oceans, as well as in forests. The overarching goal of sustainable nutrition is to manage the earth fairly in the long term. In this sense, the living situation of the current generation should be improved without endangering the life chances of future generations at the same time.

Thus, as nutrition plays a prominent, purpose-driven role in sport and is a decisive factor in performance enhancement, we want to raise awareness in the sports sector about the sustainability concept in the field of nutrition by highlighting new food routines and socio-cultural practices that sports actors should take promptly. This consists of providing sustainable and appropriate nutrition guidelines and adequate sports equipment design and use while training.

2.2. Sustainable Diets

The food we consume in our everyday life greatly impacts our environment, varying among different diets. To tackle these harmful ways of producing and consuming food, a definition of a sustainable diet was first developed in 2010 at the International Conference organised by the Food and Agriculture Organization and Biodiversity International. Currently, a sustainable diet is defined as one whose production has a little environmental impact, is protective and respectful of biodiversity and ecosystems, and is nutritionally adequate, safe, healthy, culturally acceptable and economically affordable (Agyemang et al., 2022).

A more elaborated definition is presented in the United Nations' guide "Sustainable Development Goals": "Sustainable Healthy Diets are dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable" (United Nations, 2022).

The aims of Sustainable Healthy Diets are:

1) "To achieve optimal growth and development of all individuals and support functioning and physical, mental, and social wellbeing at all life stages for present and future generations;
2) To contribute to preventing all forms of malnutrition (i.e. undernutrition, micronutrient deficiency, overweight and obesity);
3) To reduce the risk of diet-related non-communicable diseases; and support the preservation of biodiversity and planetary health."

Food ingredients and the quantity of food consumed play an important role. Another major challenge is reducing food waste, which may occur during its production, storage, cooling and transport, to reduce the burden on land resources, achieve a buffer for affordable, healthy and sufficient food for all people and avoid speculation. By 2030, the UN therefore aims to halve food waste per capita at the retail and consumer levels. Sustainable nutrition thus begins with knowledge of global interrelationships and with small and individual changes.

Correspondingly, a sustainable food production and consumption can only be achieved if the food system issues are approached systematically, looking at its connections to human health, social equity and economic prosperity and combining all the dimensions of sustainability (Swinburn et al., 2019).

In 2019, the EAT-Lancet-Commission launched the “Great Food Transformation” call to enhance healthy, sustainable diets to tackle climate change, diet-related illness, and food insecurity (Willett et al., 2019). To achieve this, the commission proposes the inclusion of plant-based dietary approaches (Willett et al., 2019). This demand is backed up by various studies identifying the reduction of animal-sourced food, especially meat, as a primary factor in contributing to ecological sustainability (Aleksandrowicz et al., 2016; Chai et al., 2019; Hallström et al., 2015). It is worth stating that a simple reduction in meat consumption (rather than a complete exclusion) can be considered helpful in this regard (flexitarian diet).

2.3. Sustainable diets related to athletes and sports

The term athlete derives from the Greek word “Athlos”, which means “achievement” or “contest”. Several definitions exist, whereas some, like the American Heart Association, highlight the competition aspect: An athlete is “one who participates in an organized team or individual sports that require regular competition against others as a core component and places a high value on excellence and achievement, requiring some form of systematic training (usually intense)” (Maron & Zipes, 2005). Similarly, the European Society of Cardiology defines an athlete as “an individual of young or adult age, amateur or professional, who is engaged in regular physical training and participates in official competitions” (Pelliccia et al., 2005). Newer definitions state that the training’s intent and volume should be key factors differentiating an athlete from an exerciser (McKinney et al., 2019). Nevertheless, for this guideline, both amateurs and professional athletes will be considered.

Meyer et al. pointed out that athletes are potentially viewed as role models by an extensive range of society and, therefore, can become powerful voices for our environmental health (Meyer et al., 2020). They are admired by children and adults alike, often seen as icons and sources of inspiration that motivate many people to adopt healthier habits and transform their lives in that respect. This is important because their followers tend to imitate what athletes eat, wear, do, etc. Historically, given that athletes' diets mainly consist of meat and other animal-derived proteins (Lynch et al., 2018), it is safe to claim that athletes’ animal-based diets are also widely espoused by their followers. That is why athletes' food choices, among one of the highest animal food consumption groups, have been subject to sustainability recently (Terzİ & Ersoy, 2022). Since they are already widely perceived as role models, they could act as such in the field of sustainable nutrition, becoming change agents for climate action (Meyer & Reguant-Closa, 2017).

It is known that athletes have specific nutritional and higher energy needs when compared to the non-athletic population. An optimal intake of energy, macro- and micronutrients, and fluids is essential to good performance in all sports (Kreider et al., 2010). According to sports guidelines, protein intake should be 1.2 – 2.1 g/kg/d (Thomas et al., 2016), but higher values are seen in strength/power training athletes and bodybuilders (Phillips, 2012). For carbohydrates, Burke et al. consider intakes of at least 5 g/kg/d (for a moderate exercise program, such as 1h/d) for fuel and recovery, but these recommendations can increase to more than double during the competition phase (Burke et al., 2011). Fat intake should be between 20-35% of energy intake.

For micronutrients, an adequate intake can enhance recovery and improve sports performance (Burke & Deakin, 2015). Athletes should consume at least the Dietary Reference Intake (DRI) because of the wide safety margins for nutrient recommendations (Rodriguez et al., 2009). Requirements of micronutrients, particularly sodium, B6, and iron, may depend on the levels of physical activity (Whiting & Barabash, 2006), but further research is needed. Besides that, the Dietary Reference Intake (DRI) for micronutrients seems to be appropriate for most athletes because of the wide safety margins for nutrient recommendations (Thomas et al., 2016), except for iron, which is 1.3 – 1.7 times higher for athletes (Institute of Medicine (US) Committee to Review Dietary Reference Intakes for Vitamin D and Calcium; Ross AC). For those who restrict energy intake to achieve weight loss or restrict a specific group of foods, more attention to micronutrient adequacy is required because of the higher risk of deficiency.

Therefore, a sustainable diet for athletes must take into account these special nutritional needs. Nevertheless, implementing a new nutritional strategy in the sports field can be challenging, as their performance can be affected. Our research findings indicate that most athletes reported a higher meat consumption.

Together with this, fruit and vegetable intake was considered low, as most athletes reported eating less than 3 portions of vegetables a day. Also, more than 2/3 never consumed plant-based alternatives. According to our questionnaire, the lack of product quality in sustainable food and the possibility of lacking some energy components (i.e., macronutrients) that they need as an athlete when undergoing a sustainable diet are a real concern. Therefore, the possibility of not getting enough protein if they decrease animal-based food sources is probably one of the most difficult challenges that must be addressed. However, their protein consumption seems to be higher than recommended (Meyer & Reguant-Closa, 2017).

On the other hand, most athletes perceived a lack of knowledge regarding food's environmental impact as the primary barrier to accessing sustainable diets. Moreover, almost 90% of the athletes are willing to reduce the amount of food they waste, while ~60% would like to limit their meat consumption. Also, more than 2/3 are willing to change their eating habits and undergo a sustainable diet even if other athletes do not.
By saying this, there is an opportunity to increase athletes' knowledge regarding sustainability so they can make more sustainable choices without compromising their performance.

In 2020, Meyer et al. listed the following five steps regarding sustainable diets for athletes (Meyer et al., 2020):

1. **Reduce animal-sourced foods (especially red and processed meat)** by increasing plant-based foods, considering a flexitarian diet and plant-forward approaches;
2. **Limit protein supplements** by practising food-first approaches using whole foods whenever possible;
3. **Reduce processed, frozen, and canned foods** by increasing food literacy and prioritising locally grown, seasonal, and fresh food;

4. **Reduce food waste** by teaching purchasing, cooking, storage, food safety, and food literacy;
5. **Avoid unnecessary packaging** by using sustainable options and evaluate solutions in light of food safety and food waste.

It is important to understand that adhering to a sustainable diet is not perceived exclusively as the athletes' responsibility. Coaches, dietitians, the management of sports organisations, and policymakers must partake in a movement enabling change in this field as well. Indeed, sports organisations and training centres can play a major role in creating sustainable diets for athletes through changing food procurement processes. For example, the International Olympic Committee (IOC) has developed the Sustainability and Legacy Commission and the Olympic Movement's Agenda 21 "to encourage members of the movement to play an active part in the sustainable development of the planet", but a deeper integration of sustainable practices in organisational structures of sports institutions and sports events is highly needed.

According to our questionnaire's results, almost all sports dietitians support the change of their athletes' diet into a more sustainable one. Nevertheless, more than 2/3 reported the lack of accessibility in their community and the lack of knowledge regarding food impact as the main barriers. Positively, around half of the dietitians disagree that there is a lack of product quality in sustainable food or a lack of some energy components for an athlete's diet when undergoing a sustainable diet. Nevertheless, ~40% are not convinced enough to change their athletes' habits and believe a more sustainable diet is not viable in their athletes' conditions. When it comes to coaches, ~50% think that there is a lack of energy components that athletes need in their diet. Around ⅓ are not convinced enough about changing athletes' habits in terms of sustainability. As athletes usually spend more time with their coaches rather than with sports nutritionists/dietitians, increasing coaches' knowledge is also paramount to facilitate the implementation of more sustainable choices in the sports field.

Nevertheless, around 80% are willing to change athletes' eating habits in order to contribute to sustainability, such as reducing meat consumption and increasing plant-based alternatives.

To conclude, as there is an emergent need to implement more sustainable choices regarding diets, and as athletes are perceived as role models in our community, evidence suggests that there is a need for the sensitisation of sports actors in favour of new, more sustainable routines and socio-cultural practices. Therefore, creating adequate guidelines providing scientific evidence to improve their diet in terms of sustainability without compromising their performance is paramount to reducing or mitigating the effects of climate change in the short, medium, and long term.

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3. HOW CAN WE INCREASE SUSTAINABILITY IN OUR DIETARY CHOICES?

Despite athletes having different energy, macro- and micronutrient needs when compared to the non-athletic population, evidence suggests that it is possible to implement more sustainable choices regarding their diet to reduce environmental impact without compromising their health and athletic performance (Meyer & Reguant-Closa, 2017; Meyer et al., 2020). Therefore, efforts should be made towards a sustainable diet, increasing plant-based sources, increasing fruit, vegetables, legumes, whole grains, nuts and seeds intake and reducing animal-based foods. Also, other factors such as seasonality, locality, smart choice of nutritional supplements, and limitation of food packaging, processing, and waste must be considered (Meyer & Reguant-Closa, 2017). The possible lack of protein due to decreasing animal-based foods is one of the biggest concerns for athletes. At the same time, studies consistently show that athletes often exceed protein intakes, consuming high amounts of red meat and poultry. Moreover, athletes are more prone to use dietary supplements, such as whey protein, casein and others, which increase their daily protein intake. The results of our questionnaires showed that athletes have limited knowledge of how to make their diets more sustainable while maintaining nutritional adequacy and they lack the guidance and support to be able to change their dietary habits. Thus, athletes need professional guidance to learn to adjust protein sources, quantity, and distribution according to the evolving evidence in protein nutrition relative to exercise (Burke et al., 2019).

The purpose of this chapter is to summarise the actions that need to be taken regarding athletes' diets to increase sustainability, taking into account their lack of knowledge and focusing on the need for practical recommendations that will increase the probability of making sustainable dietary changes.

3.1. Diets that are associated with sustainability

3.1.1. Mediterranean Diet

In the last decades, the Mediterranean diet (MD) has been extensively studied for its nutritional adequacy and beneficial health effects. This dietary pattern, resembling the traditional eating habits of people from the Mediterranean area during the 60s, is characterised by a low intake of red meat and processed meats, a moderate intake of fish, poultry, eggs and dairy and a high intake of olive oil, non-refined cereals, legumes, vegetables, fruits and nuts (Griffiths et al., 2022; Martinez-Lacoba et al., 2018).

Close adherence to MD makes the risk of nutritional deficiencies extremely low. MD offers multiple possibilities of modulation and customisation according to the individual needs to comply with specific sport nutrition recommendations. The transferability of the traditional MD pattern to non-Mediterranean populations is also possible due to its nutritional adequacy, palatability, potential for health and sustainability. Regarding athletes, the available evidence suggests that the MD model is feasible as a healthy dietary pattern in sports nutrition. Providing athletes with nutritional education about the beneficial effects of MD and recommendations tailored to the type of sport, volume of training, body composition, hydration status, food allergies or other special needs may be a useful strategy to improve athletes' sustainability without compromising their performance. With regards to this aspect, it should be noted that in recent analyses, the increased availability of non-Mediterranean foods—such as low-quality vegetable oils, sugar, sweeteners and processed meat, has been recognised as a contributor to the deterioration of the MD pattern and to the increased conformity of dietary habits observed worldwide in the last decades (Bizzozero-Peroni et al., 2022; Calella et al., 2022; Martinez-Lacoba et al., 2018; Tosti et al., 2018).

Main characteristics of the Mediterranean Diet

In 2010 the new Mediterranean Diet Pyramid was developed to represent "a lifestyle of today" with the following dietary consumption recommendations (see **table 1** and **figure 1** below). As an initiative of the Mediterranean Diet Foundation and with the collaboration of numerous international entities, a wide range of experts in nutrition, anthropology, sociology, and agriculture have reached a consensus on a new, richer design with the incorporation of qualitative elements. The new pyramid is not just about prioritising some food groups over others but also paying attention to the way of selecting, cooking and eating to acquire all the benefits offered by the Mediterranean diet, specifically moderation, socialisation, cooking, seasonality, biodiversity, eco-friendliness, traditional and local food products, physical activity and rest (Bach-Faig et al., 2011; Martinez-Lacoba et al., 2018).

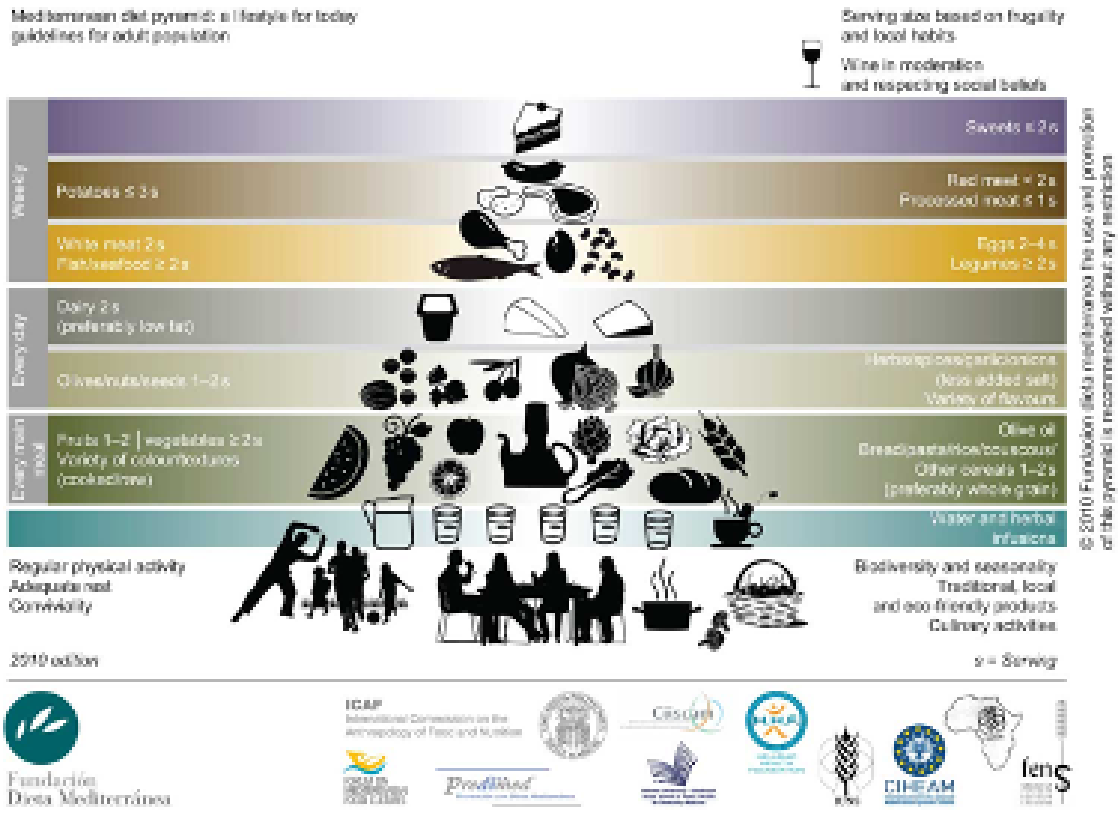

Figure 1. Mediterranean Diet Pyramid dietary recommendations (Bach-Faig et al., 2011; Tosti et al., 2018)

Table 1. Mediterranean Diet Pyramid dietary recommendations (Bach-Faig et al., 2011; Tosti et al., 2018)

Present in all or most meals of the day

- A variety of minimally processed whole grains
- Huge diversity of fresh vegetables
- Fresh fruits as the typical daily dessert in all meals
- Cold-pressed extra-virgin olive oil, olives, nuts and seeds as the principal source of fat
- Herbs and spices

Moderate consumption on a weekly basis; at least twice a week

- Legumes
- Fish, shellfish, and poultry
- Dairy products, mainly local cheese and yoghurt
- Eggs
- Potatoes
- Wine in low to moderate amounts only with meals

Low consumption; once a week or less

- Red and processed meat
- Sweets as dessert based on nuts, olive oil, and honey (mostly during celebratory occasions)

3.1.2. Planetary Health Diet

According to EAT-Lancet Commission, the term "planetary health diet" is used to highlight the critical role that diets play in linking human health and environmental sustainability and the need to integrate these often-separate agendas into a shared global agenda for food system transformation to achieve the SDGs and Paris Agreement (Willett et al., 2019). Planetary Health Diet is a flexitarian diet, which is largely plant-based but can optionally include modest amounts of fish, poultry, eggs, and dairy foods and occasionally red meat. The diet contains unsaturated rather than saturated fats and limited amounts of refined grains, highly processed foods and added sugars. Although the planetary health diet is consistent with many traditional eating patterns, it does not imply that the global population should eat exactly the same food, nor does it describe an exact diet. Instead, the planetary health diet outlines empirical food groups and ranges of food intakes, which, combined in a diet, would optimise human health. Local interpretation and adaptation of the universally-applicable planetary health diet is necessary and should reflect the culture, geography and demography of the population and individuals (Meyer et al., 2020; Swinburn et al., 2019; Willett et al., 2019).

Main characteristics of the Planetary health Diet

The EAT-Lancet Commission on Food, Planet, Health brought together 37 world-leading scientists from across the globe to answer this question: Can we feed a future population of 10 billion people a healthy diet within planetary boundaries? The answer is yes, but it will be impossible without transforming eating habits, improving food production, and reducing food waste. The EAT-Lancet Report: Healthy Diets from Sustainable Food Systems is the first complete scientific review of what constitutes a healthy diet from a sustainable food system and which actions can support and speed up food system transformation. Scientific guidelines (see **figure 2** and **table 2** below) for healthy diets are based on the extensive literature on foods, dietary patterns, and health outcomes (Willett et al., 2019).

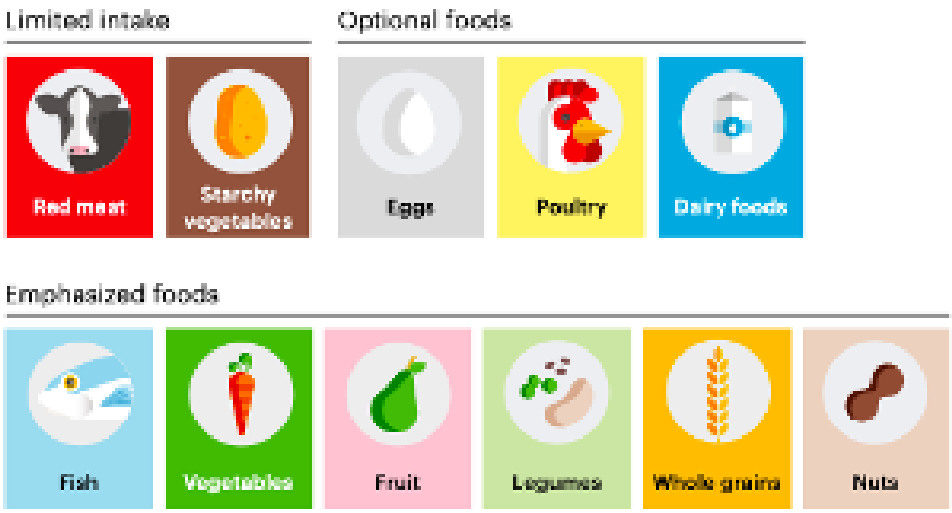

Figure 2. The EAT-Lancet Commission on Food, Planet, Health, eatforum.org

Table 2. Planetary health diet dietary recommendations (Willett et al., 2019).

Meat, fish, poultry, eggs: Animal proteins should primarily be sourced from fish or alternative sources of omega-3 fatty acids several times per week, and with optional modest consumption of poultry and eggs alongside low intakes of red meat, if any, especially processed meat. On the athlete's plate, this suggests a protein flip, moving plant-based foods to the centre of the plate while using ASF as a topping.

Fruits and vegetables: At least five servings of fruits and vegetables (500 grams) should be consumed daily, excluding potatoes.

Nuts and legumes: Nuts and legumes, including dry beans, lentils and peas, should be consumed daily.

Fats: Fats should mainly come from unsaturated plant sources with low intakes of saturated fats and no partially hydrogenated oils.

Whole grains: Carbohydrates should primarily be sourced from whole grains.

Starchy vegetables: Low to moderate amounts of starchy vegetables, including potatoes and cassava.

Dairy: Moderate levels of dairy consumption are an option.

Sweets: Less than 5% of energy.

In conclusion, both Mediterranean and Planetary Health diets ensure an adequate consumption of energy, carbohydrates, protein, and healthy fats (Baker et al., 2019; Bizzozero-Peroni et al., 2022; Westberg et al., 2022). Therefore, athletes should be encouraged to learn these dietary approaches and to implement them in their life.

3.2. Strategies to apply

1. Reduce animal-sourced foods (ASFs), especially red and processed meat; Increase plant-based foods; Consider flexitarian, plant-based dietary approaches

According to the literature, animal-based protein sources included in common diets have a significantly higher environmental impact than plant-based alternatives (Meyer & Reguant-Closa, 2017). However, athletes have a higher need to meet protein requirements, considering protein quantity and quality (e.g., amino acid profile of protein, protein digestibility), as well as nutritional adequacy.

Nevertheless, to implement more sustainable choices in an athlete's diet, it is not necessary to entirely remove animal-based foods by following a vegan/strict vegetarian diet. A more flexitarian approach, such as the Mediterranean Diet and the Planetary Health Diet, which suggests reducing (rather than removing) animal protein sources and substituting them with plant-based foods, is an excellent strategy to decrease the environmental impact, with the advantage of easily meeting the protein requirements without compromising athletic performance. Moreover, with the increase of plant-based sources, it is expectable that the intake of fruit and vegetables also increases, which are associated with vasodilatory, antioxidant, and anti-inflammatory properties, which can lead to improved blood flow, reduced oxidative stress and inflammation and thus, reduced muscle damage (Lynch et al., 2018; Meyer & Reguant-Closa, 2017; Meyer et al., 2020).

These diets have become popular alternatives to fully plant-based lifestyles among athletes for health, ethical and environmental reasons. Moreover, a flexitarian approach seems easier to implement than a strict vegetarian/vegan diet, being less complex and less prone to lead to nutritional deficiencies, such as iron, zinc, vitamin B12, and omega-3 fatty acids deficiencies. Therefore, the need to use supplements to avoid micronutrient deficiencies is lower, and whole-food consumption will be preferred.

Lastly, concerning athletic performance, most studies indicate no differences in strength, anaerobic, or aerobic performance among omnivores and athletes following plant-based diets (even vegan or vegetarian). In fact, many athletes on plant-based diets succeed in their sports, presenting high-performance levels (Burke et al., 2019; Jenner et al., 2021).

2. Stay within dietary protein recommendations; Limit protein supplements; Practice food-first approaches using whole foods whenever possible

The protein content of an athlete's diet is essential to ensure adequate muscle protein synthesis, tissue repair, and training adaptation. Carefully evaluating athletes' overall quantity, quality, and protein distribution and avoiding excess intake is the first step to an environmentally friendly approach (Burke et al., 2019; Jenner et al., 2019; Meyer et al., 2020).

Protein Quantity

The protein requirements for athletes were already presented previously. Unfortunately, there is lingering belief and practice to favour higher protein intakes for active and athletic individuals, with some studies showing excessive intakes as high as 4.3 g/kg/day (Meyer & Reguant-Closa, 2017).

It is common for an athlete to increase their protein to maintain skeletal muscle mass, and if weight loss is needed, this macronutrient may increase their satiety (Manore, 2015), having a particular interest for athletes.

However, that increase leads to a decrease in another macronutrient intake, typically carbohydrates (Phillips, 2014). Many athletes have suboptimal intakes of carbohydrates, which can be detrimental to training adaptation, health, and performance. In fact, several studies showed that the carbohydrate intake could be below the recommended (Baranauskas et al., 2015; Masson & Lamarche, 2016; Mielgo-Ayuso et al., 2015), and sometimes protein intake can be higher (Baranauskas et al., 2015; Mielgo-Ayuso et al., 2015). An optimum supply of carbohydrates is one of the most important dietary requirements for athletes (Baranauskas et al., 2015), and a restriction of that macronutrient has been shown to be detrimental (Rodriguez et al., 2009), affecting performance due to the depletion of glycogen stores and/or hypoglycemia (Burke & Deakin, 2015). Popular eating approaches, such as gluten-free, palaeolithic, and ketogenic diets or training with low carbohydrate availability, are also used by athletes. Such diets are usually high in protein, especially from animal sources, and high in saturated fat. While these diets may provide a temporary training or a necessary clinical solution, they represent high environmental costs and might undermine athletic performance (Jenner et al., 2019; Meyer et al., 2020).

Protein Quality

Even though current recommendations regarding the amount of protein to consume do not directly address protein quality, several features differentiate plant-based protein from animal-based protein. In fact, animal protein is broadly recognised as having higher nutritional quality than plant-based protein (Day et al., 2022). On the other hand, plant-based sources offer lower nutritional values due to an unbalanced amino acid composition and reduced digestibility (due to the presence or absence of anti-nutritional factors). Nevertheless, anti-nutritional factors that naturally occur in plant foods such as beans, legumes, soybeans, and cereals can also be lessened through various preparation techniques such as soaking, fermentation, and germination (Baker et al., 2019; Calella et al., 2022).

Moreover, despite these "disadvantages" in vegetable-based protein foods, including a variety of plant protein sources has consistently been shown to be nutritionally adequate in terms of providing sufficient amounts of essential amino acids (Baker et al., 2019; Burke et al., 2019; Meyer et al., 2020; Westberg et al., 2022).

Dietary supplements

Athletes are heavy users of dietary supplements, especially those rich in protein, such as protein powders, protein shakes or protein bars, typically used to optimise muscular adaptations post-exercise (Jovanov et al., 2019). While convenient, using protein supplements may lead to excessive protein consumption, which is often reported by athletes (Nunes et al., 2018). Moreover, recent research on the microbiome raises concerns about excessive protein consumption. Especially in the absence of adequate fibre, excess protein can result in fermentation in the gastrointestinal tract, which has been associated with inflammation, damage, and dysfunction (Hughes & Holscher, 2021), which compromises athletic performance. Long-term protein supplementation raises concerns not only for the deterioration of individual health but also for planetary health, especially if it is achieved mainly through animal-based sources. Nevertheless, protein concentrates, such as whey protein, are considered products with high nutritional value yet relatively low environmental impact. However, a safe, whole food first approach, high in fibre and nutrients, without an excess of animal sources and/or supplements, should be preferred in athletes to ensure optimal health, skeletal muscle support and performance, and environmental protection (Jenner et al., 2019; Westberg et al., 2022).

3. Sustainable shopping & consuming; choosing seasonal & locally grown fresh food; limiting food waste

Shop & consume sustainably

Sustainable shopping involves how food is processed and packaged. As athletes frequently eat away from home, consume snacks on the go, and dine in athletic centres during events, it is reasonable to think that this population over-consumes processed food, which leads to the excessive usage of packages.

Therefore, it is crucial to implement practices that reduce the consumption of processed foods and limit the use of unnecessary packaging. Such practices can include (Meyer et al., 2020; Willett et al., 2019):

1) The use of reusable packaging for home-cooked food and/or choosing food items with little or no packaging;
2) Limit the use of straws;
3) Invest in a good quality reusable drinking bottle (rather than purchasing bottled water);
4) Buy products with recyclable packaging;
5) Learn how to recycle.

Choose seasonal & locally grown fresh food

Vegetables or fruits from heated greenhouses cause significantly higher environmental impacts. Therefore, seasonal and fresh food consumption is generally more environmentally favourable (Calella et al., 2022). Therefore, athletes should increase their knowledge regarding seasonality, understanding which fruits and vegetables are available in each season and avoiding purchasing products that are not abundant in the current season. Also, they should be encouraged to shop at a local farmer's market, avoiding buying vegetables or fruits from other countries (Meyer & Reguant-Closa, 2017).

Reduce food waste

According to the United Nations Environment Programme's (UNEP's) Food Waste Index Report 2021, people globally waste 1 billion tonnes of food annually. Although a significant part is wasted during food production and food retail, this massive amount of wasted food can also be a consequence of the lack of time and skills in food handling, storing and, in the case of athletes, frequent travel (as they are not able to prepare their food and/or store leftovers and are more susceptible to discard unnecessary packaging due to increased consumption of portable foods).

Therefore, athletes must be taught how to reduce their food waste by learning how to plan weekly menus, make shopping lists and store leftovers (Meyer & Reguant-Closa, 2017).

4. Support behaviour change and improve the relationship with food.

For most people, making dietary changes requires motivation, effort, and consistency. Athletes may develop a problematic relationship with food, as they are more prone to undergo several weight loss attempts (Ackland et al., 2012), which increase the risk of developing eating disorders (e.g., the Relative Energy Deficiency in Sports (RED-S)) (Mountjoy et al., 2018). As optimal energy intake is essential to maintain optimal health and performance (Melin et al., 2019), lower energy availability is associated with developing physiological impairments (De Souza et al., 2019; Mountjoy et al., 2018). To implement better choices in athletes' diets in terms of sustainability, there is a need to increase their knowledge regarding nutrition, such as knowing their nutritional needs and dietary supplements, as well as getting enough support and guidance (from dietitians, clubs, coaches...) to make sustainable changes and overcome any difficulties in their eating behaviour. Moreover, it is crucial to develop new skills regarding food selection, shopping, meal planning, cooking, food safety and storage (Calella et al., 2022; Westberg et al., 2022).

3.3. Educational material to be developed

To successfully implement the strategies that were mentioned above, some educational content should be developed to increase food and nutrition literacy, such as:

1) To reduce animal-sourced foods:

a. Information about the beneficial effects of plant-based diets on health and the environment;
b. Information about the flexitarian diet or other adequate approaches;
c. Recipes including plant-based options.

2) To remain within the protein recommendations:

a. Scientific guidelines regarding nutrient intakes, performance, and dietary supplements;
b. Lists of protein-rich, plant-based alternatives (including protein content and protein quality);
c. Practical suggestions on how athletes can combine plant-based options to ensure protein quality;
d. Recipes to substitute some animal-based recipes with the same protein quantity.

3**) Sustainable shopping & consuming; choosing seasonal & locally grown fresh food; limiting food waste**

a. Lists of local products and vendors;
b. Seasonality charts (fruits & vegetables);
c. Sustainable shopping strategies;
d. Ways to limit food waste while ensuring food safety;
e. Recipes that avoid food waste.

4) Support behaviour change and improve the relationship with food.

a. Educational content to sports coaches, sports dietitians/nutritionists and others;
b. Sample daily & weekly menus;
c. Meal planning & food selection strategies.

It is essential to state that behavioural changes can be a challenge as they do not occur only by increasing knowledge (Kumanyika et al., 2000). In this context, current literature identifies some dietary behaviour change methods that can facilitate this change (please see Bentley et al., 2020), such as:

1) Information about health consequences: Increasing the knowledge about health, development, and the benefits of an adequate diet on performance can help to surface behaviour change in athletes. As athletes tend to prefer foods that are associated with an enhancement of their performance, the consequences of more sustainable options on this outcome can be used to change athletes' behaviour;

2) Goal setting: Goal setting can effectively stimulate athletes to change their dietary choices. Implementing small and achievable goals (e.g., reducing meat consumption from 5 to 3 times a week; eating a plant-based meal 2x a week) can encourage athletes to make sustainable changes in their diet.

3) Social support: Social support from their family, friends, coaches and other sports professionals is fundamental to convincing athletes to change their eating habits. Professional help, such as support from a psychologist and/or dietitian, can also expedite this process. More importantly, the collaboration between coaches and these professionals can ease this behaviour change process for athletes.

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4. THE ROLE OF NUTRITIONISTS AND SPORTS COACHES IN INCREASING SUSTAINABILITY IN THE SPORTS FIELD

A successful athletic career is not related exclusively to their efforts but also to the quality of their supporting environment, which includes the support of other professionals such as coaches and dietitians/nutritionists.

An athletic career depends on several people and not just the athlete itself. Nutritionists and sports coaches are primarily involved in athletes' careers and sometimes their personal lives, helping them achieve their sports goals and succeed professionally. For instance, coaches are an integral and the most important part of this journey. They are often role models for athletes (Arıpınar & ve Donuk, 2011) and are at the centre of athletes' socialisation. Athletes' beliefs are shaped during socialisation, that is, observation of and interaction with significant others such as coaches, teammates, and role models of the sport they perform (King et al., 2022). On the other hand, despite not having a daily presence in athletes' lives, sports nutritionists have also been an inseparable part of athletes' careers (Ulutaş & Özgül, 2020). Therefore, the role of coaches and sports nutritionists in athletes' dietary change is indisputably significant, including integrating sustainability into their athletes' nutritional choices. Furthermore, coaches and sports nutritionists should work together harmoniously to implement more sustainable decisions in an athlete's diet.

Dietitians/nutritionists are well-positioned within food systems to influence change. In fact, they work in several different areas that are relevant to this topic, such as: agriculture and food production, processing, marketing, and retail settings; health care and private clinical practice settings; community-based settings; public health and policy settings (Carlsson et al., 2020). Moreover, some professionals already work in multidisciplinary teams involving food systems and sustainability.

In the sports field, they work with athletes on a one-to-one basis, giving athletes nutritional guidance and helping them to implement adequate changes, such as:

- Weight management strategies to give athletes an advantage towards the opponent (e.g., weight-sensitive sports when there is a need to lose weight to belong in a lower weight category);
- Strategies to optimise their sports performance (e.g., carbohydrates strategies to ensure a good performance in a marathon);
- Assure athletes are not under a lower energy availability, avoiding eating disorders (e.g., RED-S).

When it comes to individual counselling (during a nutrition appointment), nutritionists/dietitians should combine the knowledge of sports nutrition with sustainability by guiding athletes towards a more sustainable diet without compromising their performance. Then, it will be necessary to increase athletes' knowledge regarding this topic and address common myths about sustainable food with them (e.g., the possible lack of protein). The diet plan should be analysed together with the athlete, and some sustainable alternatives should be proposed, for instance:

1) Reduce meat quantity and increase legumes quantity (considering the macronutrient adjustments) and/or implement plant-based alternatives such as soy, seitan, and tofu;
2) Control the supplements usage and prioritise whole foods;
3) Consider the seasonality when creating the personalised diet plan;
4) Consider the environment in which the athlete is incorporated (local markets, grocery stores, etc.);
5) Tips for reducing food waste pre- and post-consumption.

Additionally, they can create information packs, leaflets, and handouts on topics relating to sustainable diets, making these resources available not only for athletes but also for coaches for them to educate their athletes. Implementing webinars, speaker series and conferences may also be a good opportunity to increase knowledge not for one but for a whole club/association, which includes not only athletes but also other professionals.

By saying this, nutritionists/dietitians must be familiar with plant-based cuisines to make appropriate recommendations according to the athletes' culture, preferences, economic status and other factors that might be relevant (Carlsson et al., 2020). Also, these professionals must consider the possible barriers that athletes might face during this transition, such as food availability, cost, culture, etc.

Although sports nutritionists have a crucial role in prescribing what an athlete should eat, coaches are at the centre of controlling the diet of athletes (Gullu, 2018). To be able to control the nutrition consumption of athletes, coaches should enhance their awareness and knowledge about sports nutrition (Aka, 2020).

Firstly, it is important that coaches have awareness and adequate knowledge about the inclusion of plant-based diets and its effects on sports performance. When facing a change in their diet, athletes might feel nervous due to a possible decrease in their athletic performance loss. Therefore, it is essential to support athletes and their respective sports nutritionists/dietitians in following the proposed diet. They also should spread awareness regarding sustainability and, if possible, all team members should follow the same sustainability recommendations (adjusting for each specific dietary advice). This is important because the rivalry of athletes is not only with other teams but also within the team. Also, if some team players are not willing to change their diet habits, this may limit others who are, in fact, willing to do so. For this reason, coaches should welcome changes in dietary choices as a team policy.

Coaches should get support from nutritionists regarding tailored protein choices according to the needs of the athletes' specific situations, such as performance enhancement or recovery. Moreover, coaches can play a significant role in the use of supplements. Indeed, the use of supplements should be limited to when it is really necessary (e.g., long trips, competitions, last-minute snacks), and the consumption of whole food should be prioritised. In this context, the collaboration between sports dietitians/nutritionists and coaches is extremely important to ensure that the athletes have all their dietary requirements fulfilled while considering more sustainable options.

Limiting food waste, avoiding unnecessary packaging, and consuming seasonal/locally grown fresh food is the third strategy to reach sustainability in athletes' dietary choices. Indeed, reducing the amount of wasted food is considered a reasonable and practicable action which must be taken, and a large section of society has a consensus on it. According to this project study results, most coaches are willing to drive their athletes to reduce the amount of food they waste. However, they do not engage in any activities that directly promote a sustainable diet for the environment. Notwithstanding, they are suffering from a lack of knowledge regarding food impact. In conclusion, it is safe to say that although they are willing to reduce not only the amount of food they waste but also the amount of food their athletes waste, due to the lack of knowledge, they rarely take action to do so.

Coaches, sports nutritionists, and other sports workers should encourage their athletes to utilise available food waste applications to reduce food waste. Coaches and sports nutritionists can follow up on the amount of food wasted by each athlete (individually) and by all team members. Subsequently, those who are over the average of the team, national average or EU/World average can be encouraged to limit and reduce the amount of wasted food. In this vein, coaches can set some team and individual goals to reduce the amount of wasted food.

Given that choosing an animal or plant-based diet is still a dilemma for most coaches, and more studies are needed to convince coaches to drive their athletes to a more sustainable diet, avoiding unnecessary packaging and reducing wasted food appears beyond disputable and more manageable for coaches in terms of sustainability. For instance, during training and competition, athletes consume numerous bottles of water or several liquids, especially during the warmer times of the season. It is known that using reusable bottles during the competition is difficult, particularly at a professional level. Nonetheless, regardless of the athletes' level, the reusable bottle policy can be easily applied for training. In this context, coaches should nurture reusable drinking bottles during training. Moreover, coaches can set goals for their athletes to reduce waste or consume less packaged food. Furthermore, coaches should value the changes in their athletes' eating habits as much as any other goal they set for performance.

According to our study results, coaches and athletes still maintain some concerns about changing their athletes' dietary choices towards a more sustainable diet due to several reasons, such as high competition in sports, culture, and administrative pressures. In this sense, teams should integrate sustainable practices such as avoiding the enormous use of packaged foods whenever possible (Meyer & Reguant-Closa, 2017). Regardless of the level of teams, either professional or amateur, these practices cannot successfully be implemented without coaches.

When athletes travel for a competition, they are more prone to discard unnecessary packaging (increased consumption of protein bars, plastic bottles for water and other beverages, etc.). The first solution is, together with the sports nutritionist/dietitian, to plan the athlete/team diet plan during this period (before, during and after travelling) to reduce unnecessary packaging.

To summarise this chapter, a table including the strategies that were discussed in this guide, as well as how each professional can work towards its implementation, is presented below:

	Athletes	Nutritionists/dietitians	Coaches
Decrease animal-based foods	Be willing to learn about sustainability and sustainable diets; Discuss with their dietitian/nutritionist about their beliefs and fears about reducing animal-source foods; Be willing to make small changes in their diet.	Provide knowledge regarding the effects of animal-based foods on the environment; Implement a Mediterranean/flexitarian diet; Increase the intake of fruit and vegetables; Practical solutions for implementing more plant-based options; Recipes including plant-based options.	Support the diet plan that the dietitian/nutritionist prescribed; Support the athlete in following the diet plan.
Protein recommendations and supplements usage	Understand what is their optimal protein intake and try not to overconsume this macronutrient by following what is in their diet plan;	Provide the athlete with scientific guidelines regarding energy and macronutrients recommendations; Provide the athlete with the knowledge regarding the supplements usage; Practical suggestions on how athletes can combine plant-based options to ensure protein quality; Recipes to substitute some animal-based recipes with the same protein quantity.	Limit the use of supplements to when it is strictly necessary (e.g., travel, competitions, last-minute snacks); Sports facilities should provide the athlete with adequate meals prioritising whole foods.
Sustainable shopping and consuming	Implement the recommendations given by dietitians/nutritionists.	Provide lists of local products and vendors; Provide seasonality charts (fruits & vegetables); Sustainable shopping strategies.	Implement in the sports facilities policies regarding seasonality (e.g., menus with fruits and vegetables of the season). Encourage the athlete to follow the recommendations given by the dietitian/nutritionist.

	Athletes	Nutritionists/dietitians	Coaches
Limit food waste	Usage of Food waste applications; Implement the recommendations given by dietitians/nutritionists.	Encourage the use of Food waste applications; Ways to limit food waste while ensuring food safety; Recipes that avoid food waste.	Encourage the use of Food waste applications; Implement policies regarding food waste in sports facilities.
Support behaviour change and improve the relationship with food	Implement the meal planning that was elaborated with the dietitian/nutritionist.	Educational content for sports coaches and athletes; Work with the athlete on their relationship with food and eating behaviour; Facilitate the athlete's adherence to the diet by providing daily or weekly menus.	Implement the daily/weekly menus in the sports facilities. Support the athlete regarding their diet changes.

4.1. References

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