



SPECIAL NUTRITIONAL NEEDS FOR ATHLETES AND EXERCISERS

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Abstract:

The main goal of this narrative review was to incorporate the recent scientific knowledge on the special nutritional needs that are necessary for specific populations of athletes and exercisers (e.g., children, females, vegans) under several training conditions and sports, in addition to proper recommendations for safe administration. The association between nutrition, exercise, and health is an essential part of athletes' and exercisers' competitive and training programs. The quality, quantity, composition, and timing of food consumption are significant to make sure that athletes could train more efficiently to decrease the risk of illness and injury. Athletes who deteriorate their energy intake or use uncontrolled weight loss practices, eliminate certain food groups from their diet, or follow other extreme nutritional philosophies, are at greater risk for micronutrient deficiencies. Fluid intake before, during, and after exercise training or/and competition is significant, particularly in specific circumstances such as hot climates, altitude, etc. Vegetarian and vegan athletes may be at higher risk for low energy, protein, fat, creatine, carnosine, omega-3 fatty acids, as well as essential micronutrients such as iron, calcium, riboflavin, zinc, and $\beta 12$. Athletes should be adequately informed about the proper use of sports nutrition and ergogenic supplements. These products should only be used after careful evaluation for safety, efficacy, effectiveness, and compliance with relevant legislation. The most significant point to achieving complete and effective nutrition among travelling athletes is planning and preparation while eating properly and hydrated could decrease the potential adverse effects of jet lag and long flights. An effective, healthy, targeted, and complete diet among athletes of different sports should make available sufficient amounts of energy, protein, and carbohydrates depending on

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the specific sport to make certain sustained exercise training performance and to maintain and improve exercise performance.

Keywords: athletic nutrition, special needs, health, athletic performance, recommendations

1. Introduction

Athletes and exercisers should take care of their nutritional strategies with the idea that they will protect their health, cover their energy reserves, promote exercise training adjustments and athletic performance and maintain exercise training and promote recovery [1-3]. The responsibility for the provision of proper nutrition care to athletes and exercisers is shared among athletes themselves, parents, teachers, coaches, and athletic nutritionists [4]. Athletes' and exercisers' nutritional needs are mainly determined by the requirements of their physical activities and aim to achieve the best athletic performance and health [5, 6]. Suitable nutritional strategies are crucial given that they influence roughly every process in the body, such as energy production and maintenance, the rapid recovery period after exercise training, etc. [7]. Individual dietary practices might be influenced by sex, age, knowledge, attitude, area of living, and nutrition-related information resources [8]. Well-chosen eating practices have a lot to offer the athlete. However, many athletes do not meet their nutritional goals [9, 10]. Common problems and inadequacies of practitioners include: (a) poor food knowledge and inadequate cooking skills; (b) poor or insufficient knowledge of sports nutrition; (c) lack of access to dietitians/nutritionists or other reliable sources of knowledge; (d) insufficient financial resources; (e) the busy lifestyle that leads to insufficient time to obtain or consume the right foods; (f) the limited availability of good food choices; (g) frequent travel, and (h) the indiscriminate use of large amounts of dietary supplements or the failure to use proven beneficial nutritional supplements and sports foods in the proper way [9-10]. Sports nutrition is a dynamic field of science and practical application that continues to thrive in the field of support it offers to athletes. Some individual issues of modern sports nutrition that confirm the above are: Nutritional goals and requirements are not static [11]. Athletes undergo an annual training program, possibly under different training conditions (e.g., climatic conditions, training intensity, etc.), in which preparation for maximum performance is achieved by incorporating different types of training in various training cycles [12]. Accordingly, nutritional support should take into account the needs for daily training as well as their overall nutritional goals [10]. Nutrition programs should be individualized for the athlete (e.g., gender, age, training status, dietary preferences) and also take into account the specificity and uniqueness of the sport, the goals of athletic performance, and the answers to various racing strategies [13]. A key goal of training is to adapt the body to develop metabolic efficiency and flexibility, while the athlete's supportive nutrition strategies focus on providing adequate energy substrates to meet the energy requirements of the race and support cognitive function [14, 15]. Energy availability, which is generally defined as energy intake concerning the energy cost of

exercise, lays an important issue for the health and success of sports nutrition strategies [12]. Consequently, each athlete/exerciser is different, and there is not an optimal diet that covers the requirements of every athlete at all periods. As a consequence, athletes and exercisers ought to be flexible to hold this issue.

This narrative review aims to present the most recent scientific knowledge on the special nutritional needs that are essential for specific populations of athletes and exercisers (e.g., children, females, vegans) under several training conditions and sports, in addition to proper recommendations for safe administration.

2. Material and Methods

Scientific research for the present narrative review was included mainly via a systematic search of the electronic databases PubMed, MEDLINE, and EMBASE, using title words, terms such as "nutrition", "athletes", "special needs", "health", "sports", and "recommendations". Moreover, we incorporated review articles, over and above references from original research and related books. Athletic performance, nutrition, health, and special needs were all used as keywords. We required scientific studies that contained the above terms and were published in the English language between January 1990 and March 2022. Studies were included if they presented information on the nutritional need of athletes and exercisers under special circumstances and evaluated their probable effectiveness in terms of health and athletic performance, administration procedures, and recommendations. Each qualified article's title and abstract were investigated, and full-text articles were retrieved in circumstances where inclusion was doubtful.

3. Young athletes

Adolescent and/or children athletes must cover the nutritional needs associated with daily exercise training and competition requirements at the same time as making sure they have a nutrition strategy that is essential to the special demands of their development and growth [4]. To make certain that adolescent and/or children athletes meet the terms of adequate, eating patterns should consider the needs for sporting success with the nutritional considerations for healthy growth and development [9, 10]. Talented young athletes can often be invited to train with another age group or senior team, frequently in conjunction with their age group team, especially in team sports. In adolescent athletes who exercise with heavy training, low energy availability is widespread [16]. This could be lead to several adverse health issues, such as menstrual irregularities, delayed puberty, bone health, short stature, eating disorders, and enlarged risk of injury, while, in girls ≤ 14 years old, the effects of low energy availability might be more distinct [17]. For the younger age groups, there is no particular need for any change in diet on the days before the competition or the same day as the competition [15]. The main dietary goals are to minimize the risk of gastrointestinal upset and to avoid dehydration problems on hot days [15]. It may be best to avoid solid food for 2-3 hours

before the competition - the combination of exercise and stress can cause some gastric discomfort. Children can often be out in the sun for long hours to engage in sports or free play, and therefore adults should be vigilant to ensure frequent use of sunscreen and recognize possible symptoms when the child seems to have problems due to his overexposure and consequent dehydration. Plenty of fluids should always be available during sports activities, and children may need to be reminded to drink small amounts of fluids at regular intervals [15]. Conclusively, it seems that adult athletes' fluid intake guidelines could be used in children and adolescents [18].

Parents are often called upon to act as coaches for the younger age groups. Many times, they can accept these positions, without appreciation or knowledge of the nutritional needs of the athletes/exercisers and resources for the implementation of an effective training and nutrition program. The above must be first properly trained so that they can then guide young athletes rather than apply training methods or diet tactics without thorough knowledge. Athletes should be encouraged to develop good eating habits from an early age. Adolescence is a time of heightened independence, and this extends to greater freedom of choice of food and responsibility for preparing meals. The promise of athletic success can provide a powerful incentive to develop good eating habits. Reliable information and good dietary patterns can help a young person develop healthy eating practices in daily training, as well as in special preparation for the race.

The physiology of children and adolescents differs from that of adults in different ways. Thermoregulatory mechanisms are less effective in children, and therefore special attention should be paid to the environment, the patterns of sports activity, clothing, and hydration to avoid problems of hyperthermia or hypothermia [19]. Physical development is rapid during childhood/adolescence and especially adolescents need nutritional support that focuses mainly on adequate intake of energy, proteins, vitamins, and minerals [20]. Many times, young people may find it difficult to meet their nutritional needs in energy and nutrients since as we said before the requirements of exercise are added to the requirements of physical development [20]. It is also difficult for young people to develop the nutritional knowledge and time management skills to choose in all cases those foods that are needed to achieve high energy and nutrient-rich foods. Although the rate of childhood obesity continues to rise, young people, and especially athletes, need plenty of energy from food, including nutritious snacks between meals. A snack before and after school or in the afternoon before sports activities could be valuable for providing extra energy to give an energy boost during the long period between lunch and dinner.

Globally, young athletes seem to consume more energy or sports drinks than adults during their athletic activity, which of course can also be an important factor in promoting fluid intake, especially if exercise is done at high temperatures [21]. These drinks can also provide an additional source of muscle fuel, especially in sports where there are benefits to consuming carbohydrates during exercise [21]. Therefore, it seems that there are some favorable assumptions regarding the consumption of sports drinks by young athletes during exercise. There are many nutrient-rich foods for children and young people that can be taken out of the house and eaten "on foot" including

sandwiches, cereals, milk, yogurt and other dairy products, fruits, and nuts. As it is not always possible to make the right food choices available at the sports venues, parents should plan their supplies. Also, many children and adolescents do not adequately recognize the signs of their hunger until they feel tired enough and so it is good to train them to organize and prepare their food intake in time. Many young athletes seek to increase their muscle growth through exercise to achieve high athletic goals [22]. While growth and maturation are genetically determined, such cases require high-energy diet plans developed by experts to help the young athlete maximize the results of specialized training and development programs. Young athletes are advised to consume a wide range of foods and avoid the use of dietary supplements, including the use of energy drinks that contain high amounts of caffeine and are not suitable for them.

Ways to encourage good feeding practices in children:

- Encourage children/adolescents to get involved in designing menus for family meals and their special training and exercise-related nutritional needs.
- Encourage positive messages that good eating habits, including healthy food and drink choices, are part of achieving athletic success and healthy living.
- The participation of children in the supply/preparation of nutrient-rich snacks is a key parameter of their education [23].

4. The female athlete

In addition to the special nutritional needs of their sports, female athletes also face some additional nutritional needs and challenges compared to their male counterparts. Particularly: (a) they have additional requirements for certain nutrients such as iron, given that they could face heavy menstrual bleeding and variations in body temperature for the period of the menstrual cycle and their effect on fluid intake and thermoregulation; (b) they have lower energy requirements due to lower body mass and muscle mass, and perhaps a lighter exercise load; (c) they often face high pressure (especially in some sports such as rhythmic and instrumental gymnastics, synchronized swimming, etc.) to achieve lower levels of body fat than is natural or healthy for their body, and; (d) they are at greater risk of succumbing to the pressure associated with body image [18, 20, 24-26]. Additionally, pregnant female athletes might require to correct their energy consumption (including >100-300 kcal/day, as a result of increasing energy expenditure), particularly carbohydrate intake [27].

However, it is worth noting that there is tremendous pressure on many athletes to achieve an unrealistic level of body mass and body fat. This can jeopardize both their athletic performance and their long-term health, with major adverse effects on reproduction and bone health. Every athlete with menstrual problems should be aware that this is probably a warning sign and should address it by seeking professional medical advice. Athletes, like any athlete who develops anxiety related to diet and fitness, should seek specialized help at an early stage.

Conclusively, female athletes need support to consume a healthy diet to cover the requirements of their selected exercise pursuit (i.e., endurance, power, and musculoskeletal strength), under the main focus of overall health and well-being.

5. Travel nutrition

Most professional athletes are frequent travelers around the world, due to their racing obligations or the search for specialized training centers away from home. In many team sports, high-level competitions are organized in both national and pan-European leagues, which require travel and competitions on a weekly or fortnightly basis. Frequent travel can create many challenges, such as (a) changes in the normal training routine and lifestyle, due to travel; (b) climate and environmental changes creating different nutritional needs; (c) jet lag; (d) changes in specific food availability, including the absence of significant and familiar foods; (e) dependence on food provided in hotels and restaurants instead of cooking at home; (g) exposure to new foods and different food cultures; (h) "everything you can eat" temptations in sports village dining rooms; (i) risks of gastrointestinal problems due to the intake of food and water with low hygiene standards, and (j) changes in digestion and/or intestinal absorption due to travel.

Some tips to feed the athlete properly while traveling is provided below [23, 28-29]:

a. Design in advance

Research food standards and availability at your destination before you leave home. Race organizers and athletes who have re-participated in this sporting event on previous occasions may be able to provide useful information on what to expect. This can help you plan the supply of essential foods for these trips so that you can replace, at least in part, important nutrients. Contact the organizers of the restaurant in your destination to inform them about your special nutritional needs as well as the meal schedule. Make a travel diet plan that incorporates the healthiest of available foods (e.g., airline catering, roadside restaurants), as well as your snacks.

b. Eat and drink while on the go

You should know that while rest is required due to travel, it will also reduce your energy needs, but also create more opportunities for excessive energy intake, especially if you succumb to the habit of "eating due to boredom". When moving to a new time zone, adopt eating habits that match the time of arrival at your destination as soon as possible from the start of the trip. This will help your body adjust more easily to its biological clock. Be aware of possible fluid loss in air-conditioned vehicles as well as in aircraft cabins and have a fluid intake plan that keeps you well hydrated.

c. Be wary of food and water hygiene

Find out if it is safe to drink water from the local water supply network. If it is dangerous, insist on drinking fluids only through bottled water and other beverages or hot drinks.

Be wary of ice that is often added to beverages - it is often made from tap water. In high-risk environments, insist on eating food produced in good hotels or well-known restaurants. Avoid eating food from local stalls and markets, no matter how tempting it may be to have an "authentic cultural experience". with local water or soil.

d. Choose good food from the local cuisine and supplement with consuming your supplies from home

It is often a good idea to bring some snacks and favorite foods with you, especially if you are away from home for a long time and your favorite foods are not available at your destination. Remember, though, that many countries ban the importation of fresh food: check beforehand to see what is allowed so that you can avoid the risk of seizing prohibited items at the airport. Do not risk trying to smuggle food in because you may not even be allowed to enter the country. Ideas for foods that can be carried by the athlete on the trip: (a) cereal; (b) powdered milk; (c) cereal bars; (d) cakes, crackers, buns; (e) honey, jam; (f) canned fruits; (g) sports drink powder, liquid meal supplements, whey protein powder; (h) meal replacement bars and sports bars, and; (i) dried fruits and nuts.

e. Use smart tactics in restaurants and when choosing takeaways

Insist on a bi-program based on what is usually consumed at home or your new nutritional needs, instead of choosing from the foods offered in your new place of residence. Where possible, arrange menus and meals at restaurants in advance, especially when you have to attend large group meals. Where possible, consider the benefits of a buffet meal service. It is usually more efficient and offers more flexibility, allowing athletes to choose according to their individual needs. Be assertive and demanding, asking for the food provided to be prepared according to your needs - for example, without adding too much animal fat, or by cooking the meat. Avoid unplanned and unnecessary consumption of food. If catering deals only serve the main meals, make sure the meal menu includes some foods (e.g., fruit) that you can use later for your snacks.

6. Nutrition and environmental issues

6.1 Exercise in warm climates

Athletes train or compete many times in different countries, and as a result, may face several different environmental challenges. An athlete who trains or competes outdoors in winter in Russia or North America is exposed to wind, snow, and heavy cold, while an athlete who trains or competes in Saudi Arabia or Africa in mid-summer may face temperatures of 50°C and high humidity. In any case, athletes must learn to cope with the weather and not miss their training due to adverse weather conditions. Athletes are sometimes required to compete in environments that are very different from those they are used to, and this could create particular challenges. Every challenge, however, should be seen as an opportunity, and dietary strategies can be adopted to help athletes cope with environmental extremes. Sometimes the weather forecast can be unreliable, and the weather can change very quickly, so the athletes and their technical staff should be well

prepared for any eventuality. Most athletes usually train and compete in temperate climates, but this can change and vary considerably, especially for endurance athletes as well as those in team sports and especially outdoor soccer. Those athletes who usually live and train in cold climates will benefit greatly from a period of acclimatization before competing in a large warm-up event. It is also important for these athletes to gain experience in higher temperatures so that they know how to adjust their training and competition strategies, as well as hydrating behaviors and lifestyle factors when suddenly exposed to hot weather. Warm climates are best achieved by performing a series of workouts in a warm environment. Performing 10-12 workouts lasting about 60-100 minutes with moderate-intensity exercise for no more than 2-3 days will significantly help to achieve the goal of acclimatization. Athletes who are not accustomed to hot weather should be aware of the need to make some changes to their routine. Some such suggestions are listed below:

- To avoid overheating and excessive sweat loss before the start of the race/workout it may be necessary to modify the warm-up and reduce the amount of clothing worn.
- Extra fluid intake may be necessary. Because cool liquids are more digestible, consuming them from insulated bottles is important [30].
- There are many strategies specific to vests, cool towels, or cool baths that can help athletes cool down before, during, or after sessions in hot environments.

Also, some athletes drink cold and icy liquids to contribute to these cooling strategies. Since a large enough fluid intake is required to achieve a significant difference in body temperature, all of these strategies should be well tested before attempting them in a competitive environment. The athlete should consider all the possible side effects of the strategies he uses to deal with the weather. For example, increasing the intake of sports drinks to meet their additional fluid needs will also increase the athlete's energy intake and affect energy balance [31, 32].

6.2 Exercise at moderate altitudes

Athletes often undergo specialized training at moderate altitudes for some time to take advantage of the physiological adjustments that result from this type of training. Below are some adjustments that can help the athlete cope with altitude training:

- Altitude training camps is often a time when the athlete is undergoing intense training. Therefore, the athlete may need to change energy intake to be able to support the increased workout load and additional strain due to altitude.
- As the additional cost of muscle fuel comes to cover the increased workload, there is consequently an increase in carbohydrate intake during altitude training. The athlete should be more consistent with refueling strategies during training as well as throughout the day [33-35].

Cold and dry conditions at moderate altitudes cause an increase in water loss during respiration [33]. This can lead to a significant increase in fluid losses at moderate altitudes relative to sea level. The athlete should take extra care to check his hydration status during the day and exercise sessions when moving at higher altitudes, as normal

fluid intake patterns may need to be adjusted to keep up with these losses [34]. As movement and training at higher altitudes can increase oxidative damage during exercise, athletes should ensure that their diet is rich in fruits and vegetables to provide the body with the necessary antioxidants. A good level of iron is necessary to maximize redness (production of red blood cells), which is an adaptive response to altitude exposure [36]. Therefore, athletes should consume sufficient amounts of iron-rich foods and check the iron status of the body beforehand before participating in altitude training camps [36].

6.3 Exercise in poor air quality

Athletes are often called upon to train and compete in the polluted environment of large cities and are faced with high levels of fumes, clouds, and dust. This can pose particular challenges not only for athletes with respiratory problems, such as asthma but also for all athletes and their support staff who may have minor respiratory problems. It has been suggested that antioxidant supplements may help reduce the severity of symptoms by neutralizing free radicals produced in response to air pollutants. Nevertheless, it seems reasonable to ensure adequate intake of fresh fruits and vegetables to ensure good antioxidant defense [37, 38].

7. Vegetarian or vegan athletes

A huge variety of different food combinations can be chosen by athletes to meet their nutritional goals. All the necessary nutrients can be obtained in sufficient quantities from regular foods. Variety is the key to satisfying nutrient needs, but many different foods can be alternated. Preferred sources of carbohydrates maybe bread, rice, pasta, potatoes, couscous, or corn porridge. Protein should be provided from many different foods - the obvious protein-rich foods are meat, fish, eggs, and dairy products, but bread, cereals, pasta, lentils, and beans also help boost of protein diet. Widely available fruits and vegetables may vary from region to region, although many are exported worldwide. In general, our eating habits are much more international than they were in the old days, and athletes can enjoy food from different countries of the world. For example, ethnic restaurants can be found in almost every major city in the world. A visit to a restaurant that serves well-known dishes can be a special "treat" for the athletes and an opportunity to escape from the training village environment, but these should be controlled in advance. Also, the advice of local athletes can help determine the right food and restaurant choices.

7.1 Recommendations for vegetarians

Many athletes such as endurance athletes adopt a vegetarian lifestyle. This personal choice can be very healthy and in no way incompatible with success in sports. However, this choice means that athletes need to be more aware of the food choices they make to maintain energy levels, meet training and rehabilitation needs, and support the proper functioning of the immune system [39]. Vegetarian athletes may be at risk for low energy,

protein, fat, creatine, carnosine, omega-3 fatty acids, and essential micronutrients such as iron, calcium, riboflavin, zinc, and B12 [40]. Plant-based diets high in fiber can inadvertently reduce an athlete's overall energy intake due to the high volume of food and the easy filling of the feeling of fullness in the stomach. This can increase the risk of insufficient energy availability and athletes should monitor their body weight and body composition to ensure that their energy needs are met [39]. Also, some athletes may use vegetarianism as a means of limiting their energy intake to achieve the desired body: this seems to be more common in female athletes, but it also affects men [41]. In these cases, all athletes should seek the help of a trusted health professional if they feel out of control with calorie restrictions and trying to lose too much weight. It is well known that severe calorie restriction can jeopardize athletic performance, as well as reproductive health and bone health [42]. Although most vegetarians meet or exceed their protein intake requirements, however, the quality of vegetable proteins and their digestion is reduced and therefore often requires an intake of about 10% more protein than if consumed animal protein. In conclusion, the protein recommendations for vegetarian athletes are about 1.3-1.8 gr/kg BW/day from a variety of vegetable protein sources.

In another category of athletes regarding their dietary choices, vegans, i.e., those who avoid all animal proteins, including fish, eggs, etc., meeting protein needs is a more serious dietary approach [41]. Thus, for these athletes, it is very important to find a source of high-quality protein to consume in recovery from training and competitions. Dairy or soy dairy products may be suitable choices for vegetarians and vegans, respectively. If there are no animal foods in the diet, then a vitamin B12 supplement may be necessary [43]. Some vegan foods, such as meat substitutes, are fortified with B12 - which is why it is important to adopt a vegan lifestyle to learn to read food labels. Avoiding red meat means that special care should be taken to ensure that the diet contains enough iron, especially during periods of rapid growth (e.g., adolescence), for women, due to damage during menstruation, and before going to altitude for training or competition [43]. Intake of iron from plant sources should be combined with other foods that help absorb iron: for example, iron from fortified breakfast cereals is consumed at a meal containing vitamin C (a glass of orange juice) [44]. To ensure adequate calcium intake dairy products should be included in the diet, but also many calcium-fortified foods are also commercially available [44]. Finally, vegetarian athletes may be at risk for low fat intake (essential fatty acids are especially important), riboflavin, vitamin D, and zinc which should be monitored and supplemented in the diet if necessary [45].

8. Nutrition by type of sports activity

8.1 Nutrition for strength sports (e.g., weightlifting, power sports, throwing, 100-200 m sprints, etc.)

The periodic training includes resistance training, as well as specific training, such as plyometric exercises, weight lifting, and throwing. The goals of the exercise are to increase strength and power, and in the case of bodybuilders to increase muscle hypertrophy (size). The main nutritional aims associated with resistance training are to

meet the energy needs of training, recovery after training, and maximize adjustments that include increasing muscle mass. There is a culture of interest in high protein intake and nutritional supplements. In the case of bodybuilders, there is a culture of extreme diets in the last days before the race to "cut", i.e., to lose as much fat or water as possible. In the case of weightlifters, there is a culture of "making their weight according to the category" of the weight they are competing for. Competitive events often include multiple shots or throws, or rounds (e.g., qualifiers and finals).

Nutrition strategies for strength sports:

- Eat a high-energy diet to support high levels of lean body mass.
- Eat enough carbohydrates to fuel resistance training as this is the main energy fuel (i.e., glycogen).
- Eat adequate but not excessive amounts of protein as these foods can displace carbohydrate needs.
- Eat a high-quality protein source (20-25 g) immediately after your workout.
- Divide your protein intake during the day.
- Choose protein intake from low-fat foods to avoid consuming large amounts of saturated fat unnecessarily.
- In the case of bodybuilders, avoid the extreme diet before the race, and choose to achieve the loss of body fat with a safe and long-term method.
- Avoid extreme weight reductions in the case of weightlifting competitions. Choose the right weight class and allow enough time for weight loss if the loss is necessary to achieve this goal. Small weight loss in the days before the race can help to safely achieve the goal.
- For athletes who participate in throws and sprints, choose a promotional meal that keeps them comfortable during the race. If there are laps in the race or there is plenty of time between shots, make sure you have access to fluids and food to keep you properly hydrated and energized.
- Seek the advice of a sports nutrition expert if you are not able to achieve your goals easily or you want specialized advice on using supplements [4, 9-10, 46-48].

8.2 Nutrition for power sports (e.g., medium distance running, track cycling, rowing, canoeing/kayaking, and swimming)

Success is defined by the body's ability to produce very high power in competitions ranging from 1- to 10 minutes. Continuous coverage of energy systems must be well developed to meet the requirements of periodic training. Nutritional goals change substantially in the various phases of training. Goals during training include achieving an ideal physique, which usually refers to low levels of body fat, and in some sports, levels of muscle mass. The physical condition of the race can only be maintained for a short time. There may be some loss of fitness during the rest period, but athletes should try to minimize it. Performance in a race can be limited by metabolic acidosis, as a by-product of continuous high-intensity exercise. Competitive events often include multiple rounds (qualifiers, semifinals, finals, etc.).

Nutrition strategies for strength/power sports:

- Energy intake should vary between training phases depending on the training load.
- Eat moderate/high carbohydrates according to the energy needs of the training phase.
- Consume fluids and carbohydrates during prolonged workouts to support hydration and energy needs.
- Eat a source of high-quality protein (20-25 g) and carbohydrates immediately after training which is the key to promoting recovery and adjustment.
- Achieve the necessary physique for the fight by setting goals gradually with great effort and especially during the phase of basic preparation.
- Consider using supplements carefully. Options that power athletes could use include ergogenic supplements that enhance the neutralization of hydrogen cations which are intracellular β -alanine and extracellular sodium bicarbonate.
- Choose a suitable meal before the race event that keeps you comfortable during the event.
- If there are qualifiers and finals in your event, and especially if you are competing in more than one event in a session, make sure you have access to fluids and food to regain strength between matches.
- Take into account the special needs for specialized phases of training, such as altitude training. This type of workout can change your energy needs, fluid loss, and iron needs.
- Seek the advice of a sports nutrition expert if you are not able to achieve your goals easily or you want specialized advice on using dietary supplements [9-10, 48-51].

8.3 Nutrition for endurance sports (e.g., marathon, triathlon, and road cycling)

Success is defined by the athlete's ability to maintain high performance over extended periods. Nutritional goals change depending on the stage of training. The goals during training include achieving the ideal physique, which usually involves low levels of body fat, and in some sports, a muscular physique. The physical condition of the race can only be maintained for a short time. There may be some change in body composition during the post-season period of the year, but athletes should try to minimize it. Athletes are often at risk for developing problems with food and body image. Fatigue or decreased performance during a race can be caused by dehydration, depletion of energy sources, gastrointestinal discomfort, and other factors [5-6]. Opportunities for fluid and fuel intake during a race vary depending on the sport, but usually require the athlete to eat or drink "on the go" [30]. Supplies may be provided in special areas or by the support team crews or may need to be made by the athlete [30]. The competition phases differ depending on the sport e.g., from the marathon where the athlete can participate in 1-2 big events per year to road cycling where the professional cyclist can compete for 100 days a year.

Nutrition strategies for endurance sports:

- Energy intake varies between phases of training depending on its load.
- Maintaining adequate energy availability.

- Eat moderate/high carbohydrates according to the energy needs of the training phase.
- Consume fluids and carbohydrates during prolonged workouts to support hydration and energy needs.
- Eat those nutrients needed after your workout to target your recovery needs. This includes fluids and electrolytes for hydration, carbohydrates for refueling, and a source of high-quality protein (20-25 g) to promote muscle adaptation.
- Set the safe achievement of your goals regarding training based on training, with great effort during the phase of basic preparation and its perfection just before the racing season.
- Prepare for the race with carbohydrate charging techniques tailored to the event's energy needs. For races lasting more than 90 min, consider charging for carbohydrates during the last 2-3 days before the race.
- Choose a pre-race meal that further boosts fuel supply, but at the same time does not cause intestinal problems and creates a comfortable feeling for the race.
- Develop a plan for food and fluid intake during the race to maintain adequate hydration and intake of extra carbohydrates according to the energy needs of the event. About carbohydrates, the goals can range from small and frequent "micro-meals" during short events (45-75 minutes) to aggressive intake up to 80-90 gr/h in endurance races (>2.5 hours). Practice the plan during training to perfect it.
- Examine the use of sports foods and supplements carefully: options include caffeine, sports gels/bars/rinks.
- Take into account the special needs for specialized phases of training, such as altitude training. This type of workout can change your energy requirements, fluid loss, and iron needs.
- Seek the advice of a sports nutrition expert if you are not able to achieve your goals easily or you want specialized advice on using dietary supplements [51-55].

8.4 Nutrition for aesthetics and weight class sports (e.g., figure skating, rhythmic and instrumental gymnastics, diving, martial arts, etc.)

Success in aesthetic sports can be defined, at least in part, by the appearance of the athlete and a subjective judgment of how ideal he or she is in the sport. Physical skills can be aided by a small, lightweight body that makes it easier to move around in a small space. Athletes in some sports are classified in the weight category to promote competition between athletes of similar size and strength. In these sports, there is a culture of "weight management" to gain some advantage in the race [56-57]. Training loads vary depending on the sport and can range from high volume/intensity (e.g., lightweight rowing) to long but moderate energy expenditure (e.g., gymnastics). The emphasis on low body mass and low levels of body fat creates an increased risk of problems with food and body image [58].

Nutrition strategies for aesthetic and weight sports:

- Maintain adequate energy availability to meet the energy needs of training and competition as well as to promote physical development (children and adolescents).
- Eat moderate/high carbohydrates according to the energy needs of the training phase.
- Choose the weight and fat goals that are achievable and support your long-term health and athletic performance.
- Choose nutritious dense foods, as well as a good distribution of high-quality protein throughout the day, to maximize your ability to meet your nutritional goals.
- In weight class sports, choose a weight class that can be achieved safely and with minimal stress. If you feel that you are developing anxiety problems related to your diet, seek the intervention of specialists at an early stage.
- Prepare for the race without the need for extreme weight loss measures.
- If you have lost weight using techniques based on mild dehydration and reduced food intake, use the period after weighing to rehydrate and get the energy needed for the race.
- Consider using supplements carefully: there are no magic pills or filters to promote body fat loss.
- Seek the advice of a sports nutritionist if you are not able to achieve your goals easily or you want specialized advice on your weight management goals [58-61].

8.5 Nutrition for team sports (e.g., football, basketball, handball, volleyball, etc.)

Nutritional goals change depending on the training phase in the annual calendar. Main training consists of high-intensity interval training with short recovery periods: training programs vary between players, teams, and between games. Success is determined by the development of skills during the match by all the players of the team, something that requires concentration, perseverance, good judgment, and cooperation. Several desirable physiques are depending on the sport, the position of the athlete in a team, as well as other special characteristics: e.g., may include developed muscle mass and volume or less bulky and low-fat athletes. The match can be weekly or in the form of a tournament: both require post-match recovery. Fatigue or reduced performance during a race can be caused by dehydration, depletion of energy sources, gastrointestinal discomfort, and other factors [53]. The opportunities for athletes to consume fluids and carbohydrates during a race vary according to the rules of the sport [62]. There may be breaks between periods, substitutions, or informal in-game breaks that allow for nutritional support [62].

Nutrition strategies for team sports:

- Intake of the required energy and carbohydrates according to the energy needs of the training phase or the race.
- Consume fluids and carbohydrates during prolonged workouts to support hydration and energy needs.

- Consume nutrients after workouts or competitions that target recovery elements - this includes fluids and electrolytes for hydration, carbohydrates for refueling, and a high-quality protein source (20-25 g) to promote muscle adaptation.
- Set the safe achievement of your goals regarding physique, with great effort during the promotion phase and perfect it before the competitive season. Avoid greatly reducing your fitness during the post-season.
- Carbohydrate intake in preparation for the race should be tailored to the energy requirements of the race. Players with a high workload requirement should pay close attention to carbohydrate intake 1-2 days before the match.
- Choose a meal before the race, depending on the time of day, which further promotes energy supply, but at the same time does not cause unwanted symptoms in the intestine.
- Develop a food and fluid intake plan during the race, according to available opportunities. This plan should aim to maintain adequate hydration and intake of extra carbohydrates according to the energy needs of the event. Carbohydrate targets can range from small and frequent "micro-meals" during short races (45-75 minutes) to 30-60 g/h for 90-120 minute races. Practice this plan in pre-season training (preparation games) to perfect it.
- Examine the use of sports foods and ergogenic supplements carefully: options include caffeine, sports gels/bars/drinks [9-10, 64-70].

9. Conclusions

Athletes need to know the energy required as well as the timing of their intake during periods of high intensity and/or long duration to maintain their health and maximize the results of their training. The primary goal of the training diet is to provide nutritional support to allow the athlete to remain healthy and injury-free while maximizing the functional and metabolic adjustments of exercise programs. Some diet strategies allow the athlete to train hard and regain strength quickly, while others may aim at responding to or adapting to an enhanced training stimulus. Athletes should consume diets that provide at least the recommended daily intake for all micronutrients and macronutrients. Athletes who limit their energy consumption or engage in uncontrolled weight loss practices, eliminate certain food groups from their diet altogether, or follow other extreme nutritional philosophies, are at greater risk for micronutrient deficiencies. Also, fluid consumption before, during, and after exercise training or/and competition is significant, particularly in specific circumstances such as hot climates, altitude, etc. In general, nutritional supplements are unnecessary for the athlete consuming a diet that provides high availability of energy through a variety of nutrient-dense foods. A multivitamin supplement may be appropriate in some cases when these conditions do not exist. For example, if an athlete follows a low-calorie diet or is unable to consume a sufficient dietary variety. The recommendations of these supplements should be individualized; emphasizing that targeted intake of supplements may be indicated for the treatment or prevention of deficiency (e.g., iron, vitamin D, etc.). Vegetarian athletes

may be at risk for low energy, protein, fat, creatine, carnosine, omega-3 fatty acids, as well as essential micronutrients such as iron, calcium, riboflavin, zinc, and β 12. Athletes should be adequately informed about the proper use of sports nutrition and ergogenic supplements. These products should only be used after careful evaluation for safety, efficacy, effectiveness, and compliance with relevant legislation (anti-doping and legal requirements). When traveling, the most significant point to achieving complete and effective nutrition is planning and preparation, while eating properly and hydrated could decrease the potential adverse effects of jet lag and long flights. An effective, healthy and complete diet should make available sufficient amounts of energy, protein, and carbohydrates to make certain sustained exercise training performance and optimal athletic nutrition to maintain and improve exercise performance.

Conflict of Interest Statement

The authors declare no conflicts of interests.

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