Module 3. Invisible Training: Nutrition and Rest

Introduction: Nutritional recommendations for female football players: an integrated and performance-based approach

Nutrition Warm-up

The evolution and professionalisation of women's football also require adaptations and specific physical and nutritional considerations.

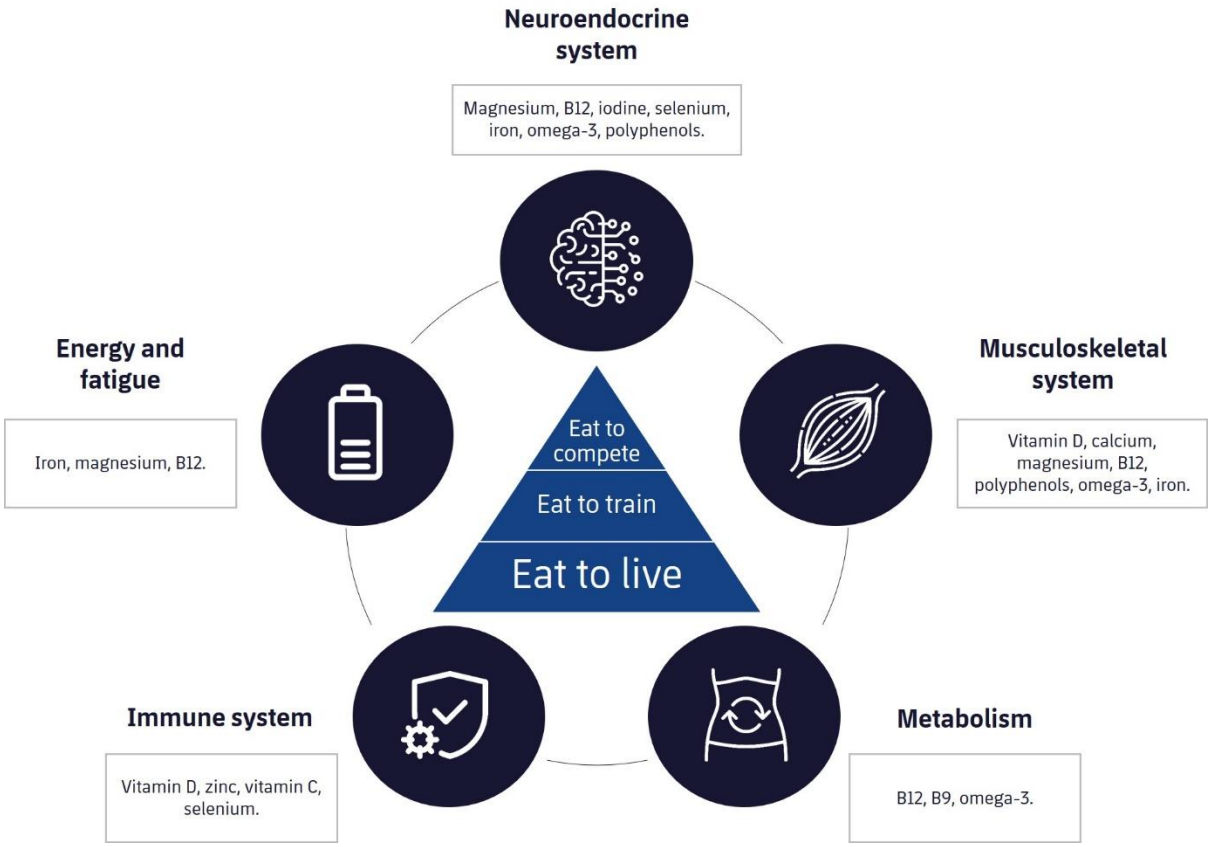
In recent years, the number of registered female football players has significantly increased, as well as the demands and intensity of the game. Not only are matches more demanding, but training sessions also involve higher workloads, double sessions, and even strength training. These changes are more noticeable in women who have had to quickly adapt to the growing demands in order to be more competitive, both on and off the field.

In starting line-ups, we can now observe more athletic and muscular players, and these athletes increasingly pay attention to the little things that can make a big difference in their profession. In invisible trainings; this is training off the field, including rest, mental health, and nutrition.

There is a growing awareness of how nutrition can affect and improve performance, and female football players are not the exception. These athletes are becoming more educated, eager to learn, and have a better understanding of proper nutrition. They know that a balanced diet can not only improve their overall health but also enhance their performance, prevent injuries, accelerate recovery between matches, and even prolong their professional careers.

A comprehensive 360-degree functional approach is necessary for female players, integrating all aspects of performance with a physiological foundation. This approach may help answer why female football players have different needs compared to male football players and even different from athletes in other sports.

Image 1: Functional Vision



Source: prepared by the authors.

Sistema neuroendocrine	Neuroendocrine system
Energía y fatiga	Energy and fatigue
Sistema Inmune	Immune system
Metabolismo	Metabolism
Sistema músculo	Musculoskeletal
Esquelético	System
Magnesio	Magnesium

B12	B12
Yodo	Iodine
Selenio	Selenium
Hierro	Iron
Omega 3	Omega-3
polifenoles	Polyphenols
Vitamina D	Vitamin D
Calcio	Calcium
B9	B9
Zinc	Zinc
Vitamina C	Vitamin C

Image 1. A 360-degree view of the nutritional physiology in the performance of female football players and the necessary nutrients.

Unit 3.1 Physiological Differences Between Women and Men

There are differences between both genders, especially between male and female athletes. These physical inequalities translate into different performances. Anatomical and physiological differences, as well as functional-metabolic differences can be observed even on the field and type of play.

The endocrine system is primarily responsible, as there are many hormones that differentiate women and men, not just those related to the menstrual cycle. All of these hormones will modify everything from the player's body composition and anatomical structure to metabolic aspects responsible for the utilization and storage of fuel, among others.

These gender differences become more evident during high-intensity efforts, as women have lower cardiac output and oxygen consumption. Additionally, muscular morphology and metabolism have their peculiarities that need to be taken into account. The glycolytic pathways and the rapid supply of ATP through anaerobic pathways are less efficient in women, who are better prepared for utilising fat as an energy substrate.

Women have greater resistance or tolerance to fatigue during prolonged efforts, but they exhibit lower efficiency in strength, power, and aspects where muscle mass is a determining factor.

This dimorphism becomes more noticeable after puberty, with an increase in testosterone in males that provides advantages such as greater height, muscle and bone mass, higher circulating haemoglobin, and better temporal-spatial orientation and competitiveness.

Despite the differences and the causality attributed to testosterone levels, which are 10 to 15 times higher in males, these differences are narrowed with the professionalism of the sport itself, and even with specific hormonal profiles of women who are better adapted to football: a more androgenic profile that can make them more competitive, (Handelsman et al., 2018).

Table 1: Physiological Differences between Men and Women that Affect Performance

MEN 	PHYSIOLOGICAL ASPECTS 	WOMEN 
More type 2 muscle fibres		More type 1 muscle fibres
Greater cardiac output (stroke volume)		Greater resistance for prolonged effort
Greater carbohydrate utilisation		Greater capacity for lipid oxidation
Higher levels of catecholamines Higher levels of testosterone Lower levels of oestrogen		Lower levels of catecholamines Lower levels of testosterone Higher levels of oestrogen
Lower percentage of body fat mass		Higher percentage of body fat mass
Greater sweating capacity		Lower sweating capacity

Source: prepared by the authors.

Table 1. In the table, the main physiological differences between men and women that can affect performance are highlighted.

Unit 3.2 Physiological Differences between Female Football Players and Athletes in other Sport Disciplines

In high-performance sports, it is not only important to consider the differences between genders, but also the increasing specialisation within sports. Small differences can be crucial for standing out in a particular sport. Significant variations can be observed among women in different sports disciplines, and gradually, we are developing more distinct profiles of top-level female football players.

We can observe anatomical, hormonal, and functional changes between athletes in aesthetic or long-distance sports and athletes in team sports, where strength and power are key. Consequently, it is necessary to modify and individualise nutritional recommendations.

It is important to provide an updated description of the profile of the female athlete we are discussing, specifically the female football player, and address her specific needs in line with her individuality that clearly sets her apart from other sports in which they share the same gender but differ in many aspects.

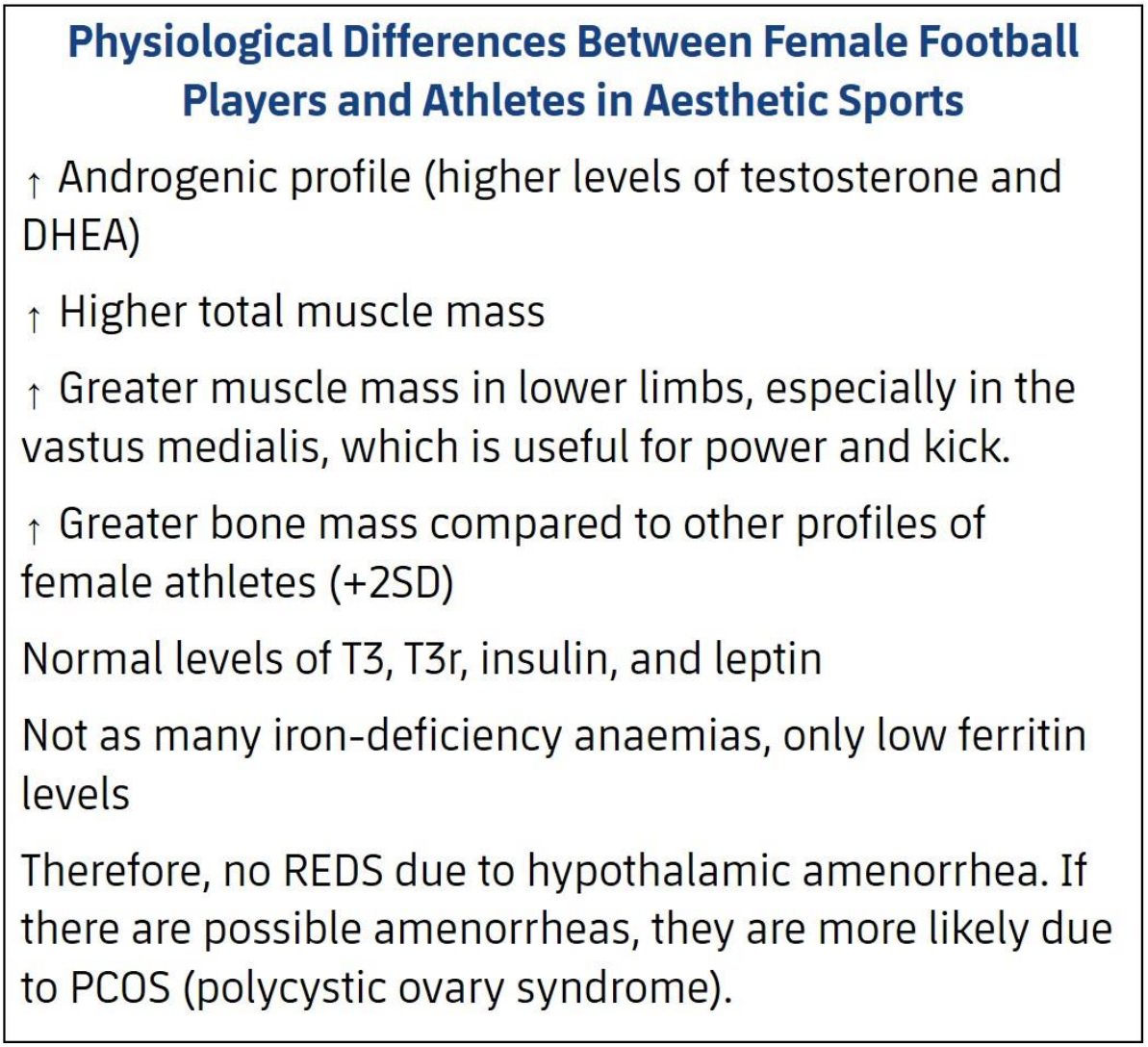
Two high-level players of different genders can have significant differences, and we can also find variations between two female sports disciplines with markedly different hormonal profiles (Sonksen et al., 2018).

Below, we summarise the most important physiological aspects found in our players.

Image 2: Female Football Player

Source: [Untitled image about female football player]. (n.d.). https://bit.ly/3xBTLcX

Image 3: Key Physiological Aspects in Elite Female Football Players Compared to Athletes from other Sports Modalities.



Source: prepared by the authors.

Unit 3.3 Body Composition

3.3.1 Measurement Systems

An optimal body composition for a female football player is crucial for performance and to avoid excess weight that can even lead to a higher risk of injuries. Therefore, it is important to have a precise and accurate protocol (Ackland et al., 2012).

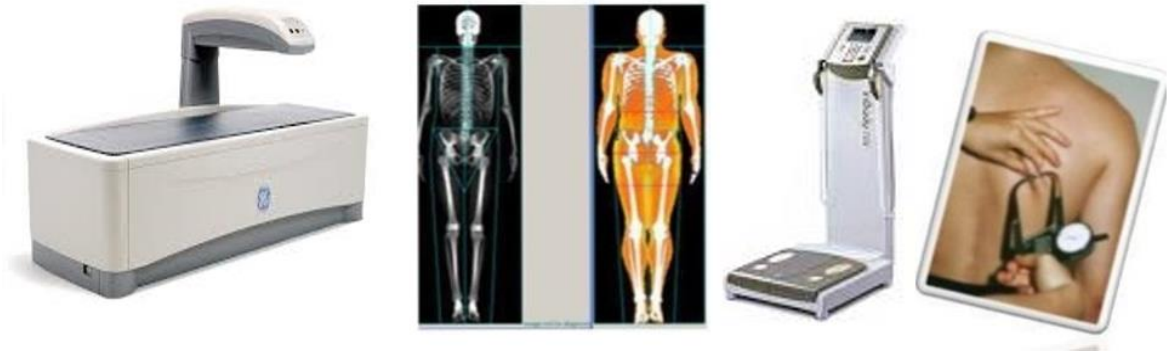
It is clear that monitoring body mass alone (weight) is not a single parameter that indicates variations in fat mass and muscle mass. Other assessment and tracking systems should be incorporated.

Ideally, having access to Dual-Energy X-ray Absorptiometry (DXA), which is considered the gold standard, and conducting measurements at least 3 or 4 times during the season (pre-season, beginning of the competitive phase, peak performance, and/or towards the end of the season) would allow observation of changes and improvements in body composition. However, due to its high cost, the most commonly used system that also provides good control is anthropometry. It should follow the international protocol of the International Society for the Advancement of Kinanthropometry (ISAK), using the 5-compartment model and even incorporating the sum of 8 skinfold measurements.

This not only provides information about body composition but also about structure, proportionality, somatotype, and anatomical indices, which help to understand the body of elite female football players (Kasper et al., 2021).

The third system used is bioimpedance, for which ensuring a proper hydration protocol is crucial for result validity. It is a rapid and non-invasive system that, depending on the model, can provide information about fat mass, lean mass, segmental data, and hydration status (intracellular and extracellular water content).

Image 4: Types of Body Composition Estimation Systems: DXA, Impedance, and Kinanthropometry



Source: prepared by the authors.

3.3.2 Differences between Female and Male Body Composition

There are obvious gender differences in muscle mass and adiposity. Women have about two-thirds of the muscle mass compared to men, with more pronounced differences in the upper body.

Differences in fat mass become more noticeable after puberty, as male hormones confer more muscle, bone mass, and taller stature to males, while female hormones are responsible for more fat and a different body distribution.

Women have 6% to 12% more fat throughout their lives, with a different distribution pattern. In men, fat tends to accumulate viscerally, in the abdominal or central region, known as android fat. In women, fat is more subcutaneous and localised in the gluteofemoral region, known as gynoid fat. Additionally, there are also differences in regional lipolysis.

While male adipocytes respond to catecholamine release during exercise and abdominal fat mobilises relatively easily, gynoid fat, which is metabolically healthier, responds to estrogenic hormonal stimuli that delay its mobilisation. It is more difficult to mobilise to preserve this fat throughout life and link it to reproductive function. However, both male and female trained athletes have intramuscular fat located near the mitochondria in the form of small droplets, known as intramuscular triglycerides, which act as an alternative to muscle glycogen.

As a result, there is a greater difficulty in mobilising and losing fat in these gynoid areas, and differences in the ability to lose weight and optimise body composition between genders. Oestrogens also seem to act in the hypothalamus, regulating appetite and the maintenance of body fat.

Image 5: Body Fat Distribution

Source: [Untitled image about body fat distribution], n/d, https://bit.ly/309fheK

Image 6: Body Fat

↑ **Total and essential fat mass**

Distribution in the gluteofemoral region (gynoid)

↓ Less visceral fat

↓ Fewer β-adrenergic receptors in the abdominal area (lipolytic)

↑ More α2-adrenergic receptors in the gluteofemoral region (antilipolytic)

↓ **Muscle mass**, especially in the upper trunk

↓ **Bone mass**

↓ **Muscle-bone index**

↓ **Lean Mass Index and**

↓ **Appendicular Mass Index**

↑ **Fat Mass Index**

↓ **Body water percentage**

Source: prepared by the authors.

3.3.3 Values of Body Composition in Professional Female Football Players

Over the past few years, our experience indicates that female football players are becoming higher, fitter, and stronger, with more athletic and muscular body types. However, we must consider that these optimal values have undergone significant changes in the last 5 or 6 years, and there are many teams where players are not as professional yet, but higher values can be found. Professionalism, strength training, and improvement in dietary habits will be crucial in transforming players into more functional and competitive individuals on the field.

We observe averages of 16% to 22% body fat using DXA, and in anthropometry, a sum of 8 skinfold measurements ranging from 65-80 mm during competitive phases. These values slightly increase during the pre-season, after the holidays. In terms of players' positions, we do not observe significant differences among field players, but a slight increase can be seen in goalkeepers.

To assess muscle content, measurement of circumferences according to the ISAK protocol is required. DXA can provide functional indices such as total lean mass index, leg lean mass index, and trunk lean mass index. It not only allows tracking the individual player's progression throughout the season but also enables comparison with the rest of the team. Furthermore, differences between lower limbs and asymmetries can be significant for injury management and prevention methods.

Image 7: Interesting Parameters and Indices for Assessment and Evolution:

Source: prepared by the authors.

Composición corporal, índices anatómicos y funcionales	Body composition, anatomical and functional indices
Peso	Weight
Talla	Height
Envergadura	Arm span
Somatotipo	Somatotype
DXA % M. Grasa	DXA body fat percentage
DXA grasa abdominal	DXA abdominal fat
∑ 6 y 8 pliegues	∑ 6 and 8 skinfold
Músculo-óseo	Muscle-bone index
Masa ósea	Bone mass
Índice envergadura relativa	Relative arm span index
Índice córmico	Cormic index
Índice manouvrier	Manouvrier index
Lean mas index	Lean mass index
Apendicular lean mas index	Apendicular lean mass index
Fat mas index	Fat mass index
Abdominal fat mas index	Abdominal fat mass index

3.3.4 Key Points for Assessing Body Composition

1- Body composition is a performance-limiting factor and should be part of the monitoring protocol for a team.

2- Avoid a simplistic approach to body composition; do not rely solely on measuring weight.

3- Focus on the most important component for the female football player: muscle mass, not just fat mass. This includes muscle mass in both the legs and the trunk.

4- Whenever possible, use and combine different methods: kinanthropometry, DXA, and body impedance.

5- Follow a proper measurement protocol, especially with DXA and bioimpedance. This includes emptying the bladder before the test, waiting at least three hours after a meal, and avoiding the luteal phase of the hormonal cycle and states of dehydration when using impedance.

6- Utilise the 5-component method with the ISAK system.

7- Aim to obtain the sum of Σ8 skinfolds (not just Σ4).

8- Do not overlook circumferences (which estimate muscle mass and waist-to-hip ratio).

9- Do not overlook bone diameters (at least once per season).

10- Include a somatogram and data on anatomical structure, such as sitting height and arm span (important, especially for goalkeepers).

11- Use functional indices if possible: Fat Mass Index, Lean Fat Mass Index, Leg Lean Mass Index, etc.

12- Observe asymmetries (for injury prevention).

13- Pay attention to pubertal development in youth players.

14- Perform measurements at appropriate times during the season (pre-season, end of pre-season, and at least twice during the competition period).

15- Use the data to motivate and educate the coaching staff and players.

Unit 3.4 Hydration

The body is approximately 60% to 70% water, but significant amounts of body water can be lost through sweating during exercise.

Body water losses equivalent to 2% of the player's body mass before exercise can have detrimental effects. They can affect both health and performance. They are known as hypohydration, more commonly referred to as dehydration. These effects have been shown to impact both mental and physical performance, and can even increase the risk of muscle cramps.

The rate of fluid loss during exercise can vary depending on heat, humidity, exercise duration, and exercise intensity.

While the trend of fluid loss will be similar among individuals in these different conditions, the actual fluid loss will vary from player to player, and there are differences in sweat rates between males and females, with higher sweat rates observed in males (Rollo et al., 2021). Women have more difficulty in thermoregulation, especially during the luteal phase.

3.4.1 Types of Tests and Hydration Assessment

The recommendations and possible tests for monitoring hydration are:

1- **Weighing before and after** training to ensure that losses are < 2% (Collins et al., 2020). And then, drinking the difference in weight lost in water multiplied by 1.5 during the next few hours after the match or training session.

2- **Sweat rate.** Taking into account not only pre- and post-training weighing, but also fluid intake and urine losses. Calculation formulas that you can check on this GSSI link: https://www.gssiweb.org/toolbox/fluidLoss/calculator

3- **Urine colour analysis**

Analysing the volume and colour of urine is an economical and easy-to-use indicator of hydration status. It can assist with daily hydration monitoring. Both low urine production and darker urine colour can indicate dehydration.

The following image can be used as a visual guide.

Image 8: Hydration Visual Guide

Source: prepared by the authors.

Dark urine colour (orange-like colour similar to apple or peach juice) can be a sign of dehydration, whereas light urine colour (pale yellow, similar to lemon juice) can indicate good hydration status.

4- Urine Osmolality

A more detailed analysis of urine can also be used as a marker of hydration status, such as urine specific gravity (USG) and urine osmolality (UOsm). Specific methods for measuring USG and UOsm should be those described for the specific equipment used.

The following table shows the associated values and thresholds for classifying the likelihood of the player being hydrated, minimally dehydrated, or dehydrated.

Table 2: Urine Osmolality and Hydration Status Values

OSMOLALITY VALUE	HYDRATION STATUS
<700	**HYDRATED**
700-900	**MODERATELY DEHYDRATED**
>900	**DEHYDRATED**

Source: prepared by the authors based on Thomas et al., 2016, p. 515.

5- Sweat Electrolyte Test

The sweat test is a set of measures to determine both the amount of sweat lost and the composition of sweat lost during exercise. It provides a more detailed analysis of electrolyte loss, particularly sodium (Baker, 2016). These tests are conducted using patches placed on the player's forearm. Each player may have a different sweat rate and sweat composition. And this data can help in creating individualised pre-hydration protocols.

3.4.2 Hydration Recommendations

The general pre-hydration recommendations can be detailed in the following table.

Table 3: General Recommendations

Before	2 to 4 hours prior to exercise, it is recommended for a player to consume about 5 millilitres of fluid per kilogram of body mass. However, especially for evening or night matches and for players who tend to dehydrate and experience cramps, hydration should be a priority from early in the morning. In hot environments, pre-cooling strategies should be added.
During	During exercise or a match, the goal is to ensure that fluid losses do not exceed 2% of body mass. In hot environments, taking advantage of cooling breaks is advisable.
After	After exercise or a match, it is recommended to consume approximately 150% of the amount of fluid lost during exercise.

Source: prepared by the authors.

3.4.3 Pre-cooling Strategy

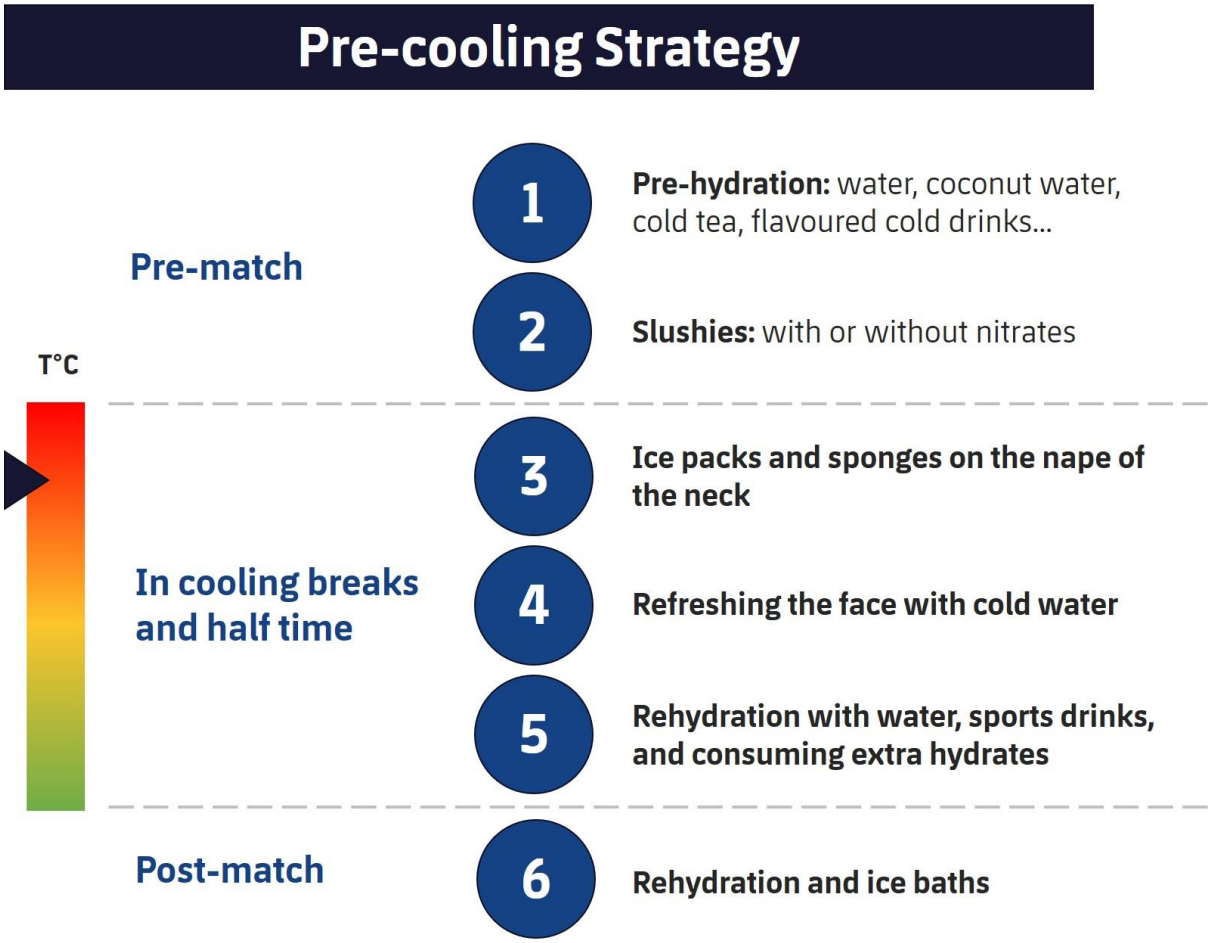
In high temperatures and high humidity, the risk of dehydration is greater. Therefore, it is essential to pay even more attention to this aspect and introduce additional strategies for regulating body temperature, known as pre-cooling strategies.

The following infographic summarises the key points.

- Early pre-hydration with drinks that can be plain mineral water, coconut water, flavoured drinks and/or electrolyte drinks, as well as chilled beverages such as slushies with or without other ergogenic substances.
- Regulating body temperature with ice or cold water sponges on the nape.
- Ensuring good hydration and taking advantage of cooling breaks during play in hot environments.

- Proper rehydration, as mentioned earlier, along with the recovery of other nutrients.

Image 9: Precooling



Source: prepared by the authors.

Estrategia 'precooling'	Pre-cooling Strategy
Pre-partido	Pre-match
En cooling breaks y media parte	In cooling breaks and half time
Post-partido	Post-match
Pre-hidratación: agua, agua de coco, tes fríos, bebidas con sabores frías...	Pre-hydration: water, coconut water, cold tea, flavoured cold drinks...

Granizados: con o sin nitratos	Slushies: with or without nitrates
Bolsas de hielo y esponjas en la nuca	Ice packs and sponges on the nape of the neck
Refrescarse la cara con agua fría	Refreshing the face with cold water
Re-hidratarse con agua, bebidas deportivas y tomar un plus de hidratos	Rehydration with water, sports drinks, and consuming extra hydrates
Re-hidratación y bañeras de hielo	Rehydration and ice baths

Unit 3.5 Nutritional Needs for Female Football Players

Nutrition encompasses and modulates every moment of sports activity, both on match days and during training and rest days. It is also a key factor in accelerating injury recovery and reducing discomfort caused by physical exercise.

Energy needs depend mainly on energy expenditure and basal metabolism, which is largely dependent on lean body mass, which is lower in women. We need to ensure correct caloric intake for female football players, especially during peak pubertal periods or situations with increased energy expenditure and stress due to travel or competitive phases. It is perhaps in these situations where we need to pay more attention (Logue et al., 2020).

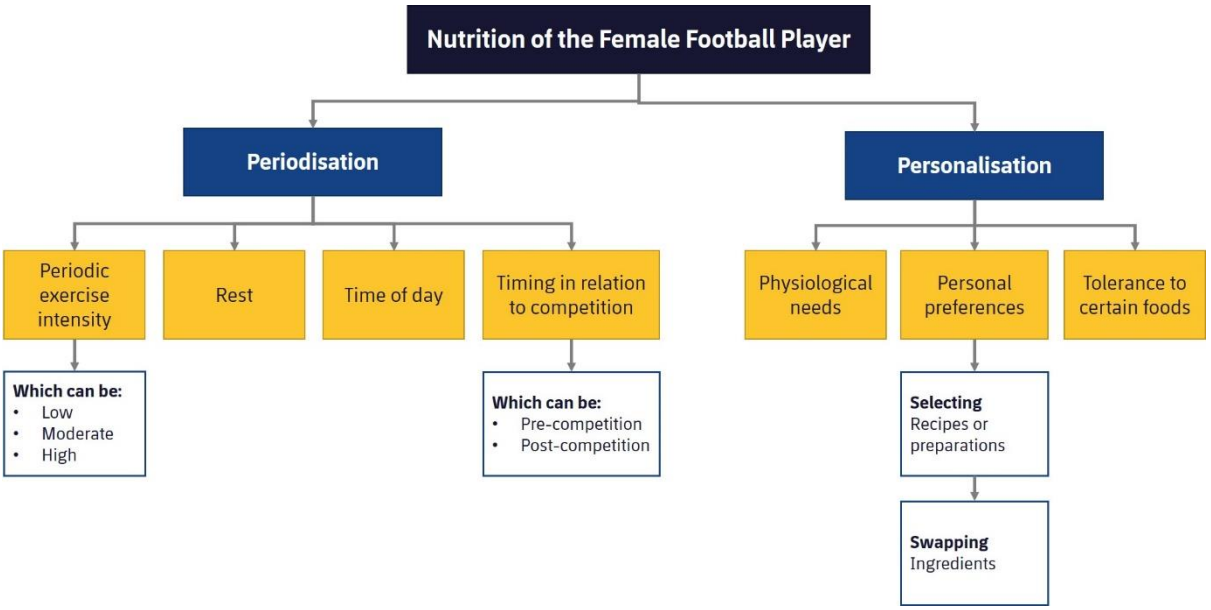
However, calculating this energy availability is difficult to carry out with "controversial" mathematical formulas, but the impact of low energy availability can be detected through other means such as hormonal and nutritional biomarkers. So that the condition, initially called the female athlete triad, which has evolved into a broader spectrum known as REDS, involves hormonal alterations with hypogonadotropic hypogonadism and amenorrhea in female athletes, although it may not be the only cause. Having a broad understanding of physiology is essential to detect and treat these cases correctly.

It is not just about covering energy; we do not eat calories. Nutrition is much more; it can modulate inflammation and immunity. The focus is on the nutritional quality of the diet, modulation of inflammation and immunity, recovery strategies, and even personalisation based on genetics.

When it comes to improvement and winning, every detail counts, so we encourage professionals to embrace this step from the lab to the table. Fortunately, in recent years, most players and their support systems recognise the impact of nutrition on performance and well-being.

To achieve this, two objectives are key: **periodising** nutrient intake according to the specific needs of each period of the season and **personalising** dishes based on each player's preferences and intolerances.

Image 10: Nutrition of the Female Football Player



Source: prepared by the authors.

Alimentación de la futbolista	Nutrition of the Female Football Player
Periodización	Periodisation
Intensidad periódica del ejercicio	Periodic exercise intensity
Descanso	Rest
Momento del día	Time of day
Momento respecto la competición	Timing in relation to competition
Que puede ser	Which can be

Baja, media, alta	Low, moderate, high
Pre competición- post competición	Pre-competition - post-competition
Personalización	Personalisation
Necesidades fisiológicas	Physiological needs
Gustos personales	Personal preferences
Tolerancias a ciertos alimentos	Tolerance to certain foods
Seleccionando	Selecting
Recetas o preparaciones	Recipes or preparations
Intercambiando	Swapping
Ingredientes	Ingredients

Next, we will present and evaluate the most important points to consider if we want to properly nourish our players.

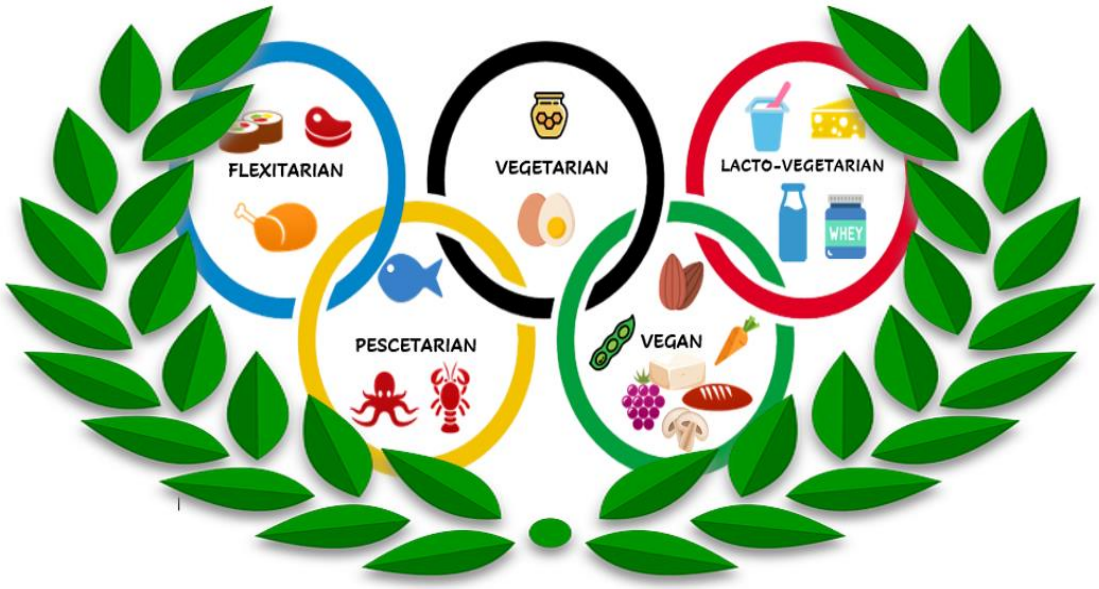
3.5.1 Personalisation

Personalisation:

- Physiological needs
- Personal tastes, preferences, or dislikes
- Food tolerances

Personal preferences and cultural and religious traditions play a significant role in nutrition. We have increasingly diverse dietary preferences, not just omnivorous diets (where the player consumes all food groups); choices such as vegan, vegetarian, and flexitarian diets are becoming more common. Therefore, understanding the type of diet and adapting to their needs is essential.

Image 11: Variety of Dietary Preferences



Source: prepared by the authors.

Types of Diets

- Flexitarian: Occasionally, they eat high-quality fish or meat (organic or free-range) and avoid processed foods.
- Pescetarian: No meat.
- Vegetarian: No meat, fish, or seafood.
- Lacto-vegetarian: Avoids all animal-derived foods except dairy.
- Vegan: Does not consume any animal-derived foods, including honey.

On the other hand, we will have to respect and adapt to cultures where religious and dietary aspects may interfere with the player's daily life. A good example is in Muslim culture during Ramadan, where fasting (abstaining from food, drinks, and water) must be observed during the day for approximately one month. Consumption is only allowed at night, from sunset (*iftar*) until sunrise (*sohor*). This situation is an excellent example where it will be crucial to closely monitor the player, not only in terms of nutrition but also regarding hydration and rest.

From a clinical perspective, there are also needs for modified diets based on specific types of foods, particularly for intolerances, food allergies, and gastrointestinal discomfort.

The most common adapted diets that may be required include:

- Lactose-free diet
- Gluten-free diet

- Fructose and sorbitol-free diet
- Low FODMAP diet, which involves reducing fermentable oligosaccharides, disaccharides, monosaccharides, and polyols.

3.5.2 Periodisation

Chrononutrition and periodisation are well-known concepts in the field of nutrition. It refers to adapting the diet to the intensity of physical exercise, providing more or fewer carbohydrates based on the competitive schedule and the external load of training sessions. However, it is not just about energy load before matches but also about adjusting the diet to specific objectives, such as aiding in better recovery during matches or double sessions, or even learning to metabolise fats more efficiently, allowing the reserved carbohydrates to be used during key moments of higher intensity (Moore et al., 2022).

However, implementing and achieving its effectiveness requires more than just a numerical strategy of grams of food. We are advocates of education, explaining why a certain way of eating is required on certain occasions and different on others. It is important for the players themselves to understand why they need to modify their diet based on their schedules, objectives, and training sessions. That's why it is crucial to provide easy-to-follow, visual, effective, and educational tools.

An example of this can be seen in the following images: a visual scheme of nutritional periodisation based on training load. Variations in carbohydrate intake are indicated based on training load, match schedule, player's availability, and minutes played. All of this is represented simply using colours.

Table 4. Nutrition Periodisation Guidelines

Nutrition Periodisation Guidelines

	Breakfast	Training	Lunch	Tea	Training	Dinner
Monday		MD+1 Training				
Tuesday		Free				
Wednesday		MD-4 Training			Training	
Thursday		MD-3 Training				
Friday		MD-2 Training				
Saturday		MD-1 Training				
Sunday		Match	If you have played > 60´ If you have not played	If you have played > 60´ If you have not played		If you have played > 60´ If you have not played

Source: prepared by the authors.

Periodización nutricional orientativa	Nutrition Periodisation Guidelines
Desayuno	Breakfast
Entreno	Training
Comida	Lunch
Merienda	Tea
Cena	Dinner
Lunes	Monday
Martes	Tuesday
Miércoles	Wednesday

Jueves	Thursday
Viernes	Friday
Sábado	Saturday
Domingo	Sunday
Entreno MD+1	MD+1 Training
Libre	Free
Partido	Match
Si has jugado	If you have played
Si no has jugado	If you have not played

Carbohydrates

Traditionally, nutritional recommendations for female football players were similar to those for male players, with carbohydrate recommendations of up to 10-12 g/kg on match days, as if it were an ultra-endurance sport. However, it's completely unreal the actual carbohydrate consumption of female players.

When considering carbohydrates, there are other factors to take into account, such as variation, digestibility, and fibre content. It is important to consume unrefined, whole carbohydrates to obtain a better fibre and micronutrient intake. However, on match days, it is recommended to avoid them to facilitate gastric emptying.

It is also essential to avoid relying solely on pasta and rice, which are typical in athletes' diets. Instead, incorporate legumes and other sources of grains, pseudo cereals, and tubers as a varied source of carbohydrates. Examples include quinoa, amaranth, millet, buckwheat, potatoes, sweet potatoes, etc.

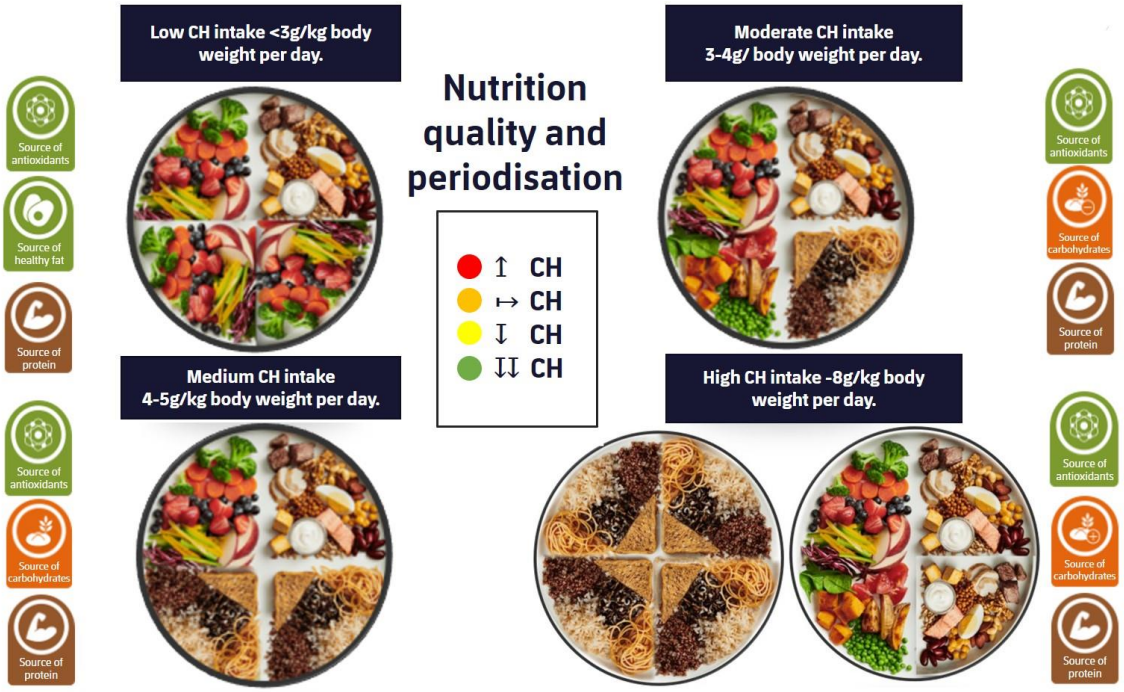
For practical nutrition periodisation recommendations, the following colour-coded guidelines can be followed, associating colours with carbohydrate quantities:

- Green colour: Low carbohydrate intake < 3 g/kg per day.

- Yellow colour: Moderate carbohydrate intake < 3-4 g/kg per day.
- Orange colour: Medium carbohydrate intake < 4-5 g/kg per day.
- Red colour: High carbohydrate intake 6-8 g/kg per day.

To avoid the need for weighing food, simpler and visual methods can be used, such as home-made portion sizes or the "**plate theory,**" which is a widely used nutrition strategy in both the general population and athletes.

Image 12. Nutrition quality and periodisation



Source: prepared by the authors.

Calidad y periodización nutricional	Nutrition quality and periodisation
Bajo CH<3g/kg peso	Low CH intake < 3g/kg body weight per day.
Medio	Medium
Moderato	Moderate
Alto	High

Fuente de antioxidantes	Source of antioxidants
Aporte grasa saludable	Sources of healthy fat
Fuente de proteína	Source of protein
Fuente de hidrato de carbono	Source of carbohydrates

A good way to understand how this method works is through a visual example, such as the poke bowl shown in the image below. It is designed to be customisable and adaptable, allowing for modifications in the proportion and variety of ingredients based on different circumstances. This enables easy personalisation and periodisation of the plate, including the proportion of carbohydrates, proteins, and vegetables, and thus the nutrients provided by each of these types of food.

Image 13: Example of How to Personalise a Poke Bowl (Omnivorous and Vegan) and Periodise it Into Three Levels of Activity: Low (-), Moderate, and High (+).

Source: prepared by the authors.

3.5.3 Nutrients to Highlight

To bring out the best version of the player, theoretical knowledge about nutrients won't be of much use if we don't put it into practice. The following phrase sums up what we want to convey: **"Luck or knowledge or luck of delivery?"** Education will be crucial for

implementing and establishing habits. In addition to the following recommendations, recipes, cooking courses and workshops, shopping lists from recommended brands, knowing where to find the most suitable quality foods, and discussing and debunking the growing myths about food on social media are important.

Fats

Regarding fat recommendations, they are not very different from those for the general population. The quality of fats is most important, so we should avoid saturated fats and trans fats found in animal-based and processed food.

Perhaps where we should emphasise more is on the ratio of omega-6 to omega-3 to optimise the omega index. It is important to consume a diet high in omega-3, especially EPA and DHA, in order to modulate the inflammation caused by intense physical exercise.

Image 14: Nutritional Recommendations That can Help Modulate Inflammation, The Following Food and Supplements Would be Highlighted.

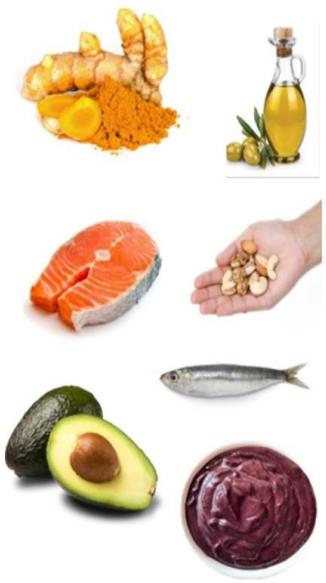
Enhance diet with anti-inflammatory action

Curcumin phytosome: recovery protocol and injury phase.

Omega-3: 1-2 capsules per day, according to individual needs.

Potential anti-inflammatory foods:
- >2-3 servings of oily fish per week.
- Handful of nuts daily.
- Use seeds such as chia, flax, and sesame daily.
- Cook and dress with extra virgin olive oil.
- Incorporate food such as avocado, legumes, edamame, olives, olive tapenade, açaí.

Reduce pro-inflammatory food:
Alcohol, red meat, processed meat, high-fat dairy, sugar, processed food. Palm and trans fats, vegetable oils (excluding extra virgin olive oil).



Source: prepared by the authors.

Potenciar alimentación con acción antinflamatoria	Enhance diet with anti-inflammatory action
Cúrcuma fitosomada: protocolo de recuperación y fase lesional	Curcumin phytosome: recovery protocol and injury phase.

Omega 3-1-2 cápsulas al día, según necesidades individuales	Omega-3: 1-2 capsules per day, according to individual needs.
Potencial alimentos anti-inflamatorios: >2-3 v/semana pescado azul Puñado de frutos secos a diario. Utilizar semillas como chía, lino y sésamo a diario. Cocinar y aliñar con aceite AOVE. Utilizar alimentos como: aguacate, legumbres, edamames, olivas, olivada, açaí	Potential anti-inflammatory foods: >2-3 servings of oily fish per week. Handful of nuts daily. Use seeds such as chia, flax, and sesame daily. Cook and dress with extra virgin olive oil. Incorporate food such as avocado, legumes, edamame, olives, olive tapenade, açaí.
Reducir alimentos pro-inflamatorios: Alcohol, carnes rojas, embutidos, lácteos grasos, azúcares, procesados. Grasas de palma y trans, aceites vegetales (que no sean de AOVE).	Reduce pro-inflammatory food: Alcohol, red meat, processed meat, high-fat dairy, sugar, processed food. Palm and trans fats, vegetable oils (excluding extra virgin olive oil).

Proteins

In a basal state, there does not seem to be a difference in protein synthesis between males and females, although the absolute activation of mTOR for muscle synthesis is higher in males. The main regulatory factor for muscle response increase is considered to be the hormonal difference with higher testosterone levels in males. In addition to differences attributed to the type of exercise program, which can influence both sexes.

Therefore, a protein intake of ≈1.6-2 g per kg of body weight is advised, fractionated throughout the day and between meals using protein bowls, with approximately ≈25 g of protein every 4 hours, ensuring it is of high quality: 1000-3000 mg of leucine, the amino acid most responsible for MPS activation (Moore et al., 2022).

In situations involving weight control, improvement of body composition, or injury, protein intake could be increased to ≈2-2.4 g per kg of body weight.

The challenge lies in ensuring that protein sources are of high quality, varied, and with a balance of plant origin. This includes avoiding processed meat, reducing red meat,

promoting oily fish or other seafood sources such as shellfish or cephalopods, in addition to dairy and eggs as animal protein sources, which are both complete and affordable.

Considering the current environmental footprint and sustainability, it is also important to consider plant-based options—along with legumes, seeds, pseudo cereals, and nuts—such as tofu, textured soy protein, tempeh, or seitan, which are increasingly used not only by vegan football players but also due to cultural and environmental respect, leading many players to enhance their plant-based diets.

From a practical standpoint, the most challenging aspect is following the protein recommendations between meals. Choosing sports snacks with sufficient protein content is key. Here are some ideas.

Sports Snacks:

Protein yoghurt bowl with fruit and seeds.

Melon or pineapple with ham or turkey.

Cottage cheese with berries and oat.

2 portions of protein jelly with fruit.

Egg wrap with salad or salmon and avocado.

Homemade protein ice cream with fruit.

Other more elaborate recipes in which protein powder can be added to transform a traditional recipe into one rich in protein for athletes.

Protein panna cotta or flan with strawberry coulis

Protein brownie

Protein pancakes

Açaí bowl with protein and toppings

Protein mug cake

etc.

Image 15. Protein yoghurt bowl of your choice

Protein yoghurt bowl of your choice

Ingredients:
Protein yoghurt or cottage cheese.
Different colour fruit of your choice.
Handful of mixed nuts: almonds, walnuts, cashews, hazelnuts, pistachios, pine nuts, Brazil nuts, (optional).
Teaspoon of mixed seeds: chia seeds, sesame seeds, hemp seeds, sunflower seeds (optional).
Oat or unsweetened granola or puffed cereals for an energy boost (optional).
Toppings: cacao nibs, cocoa powder, shredded or sliced coconut, cinnamon (optional).

Preparation:
Simply combine the selected ingredients in a bowl and enjoy your healthy snack.

Properties:
- High protein content.
- Nutrient-dense snack with vitamins, minerals, fibre, and antioxidants.
- Provides satiety due to the protein and fibre content.

Source: prepared by the authors.

Bol de yogur proteico al gusto	Protein yoghurt bowl of your choice
Ingredientes	Ingredients
Yogur proteico o queso fresco batido. Fruta/s a elegir de distinto color. Puñadito de frutos secos: almendras, nueces, anacardos, avellanas, pistachos, piñones, nueces de Brasil, (opcional). Cucharadita de semillas: chía, sésamo, cáñamo, pipas (opcional). Para un plus de energía, avena o granola sin azúcar o cereales hinchados (opcional). Toppings: nibs de cacao, cacao en polvo, coco rallado o en láminas, canela... (opcional)	Protein yoghurt or cottage cheese. Different colour fruit of your choice. Handful of mixed nuts: almonds, walnuts, cashews, hazelnuts, pistachios, pine nuts, Brazil nuts, (optional). Teaspoon of mixed seeds: chia seeds, sesame seeds, hemp seeds, sunflower seeds (optional). Oat or unsweetened granola or puffed cereals for an energy boost (optional). Toppings: cacao nibs, cocoa powder, shredded or sliced coconut, cinnamon (optional).

Preparación	Preparation
Solo tienes que poner en un bol los ingredientes seleccionados y disfrutar de tu saludable snack	Simply combine the selected ingredients in a bowl and enjoy your healthy snack
Propiedades	Properties
Alto aporte proteíco Snack de gran calidad nutricional con vitaminas, minerales, fibra y antioxidantes. Gran poder saciante gracias a la proteína y fibra.	High protein content Nutrient-dense snack with vitamins, minerals, fibre, and antioxidants. Provides satiety due to the protein and fibre content
Fuente de hidratos de carbono	Source of carbohydrates
Fuente de proteínas	Source of proteins
Fuente de antioxidantes	Source of antioxidants
Salud sistema inmune	Supports a healthy immune system

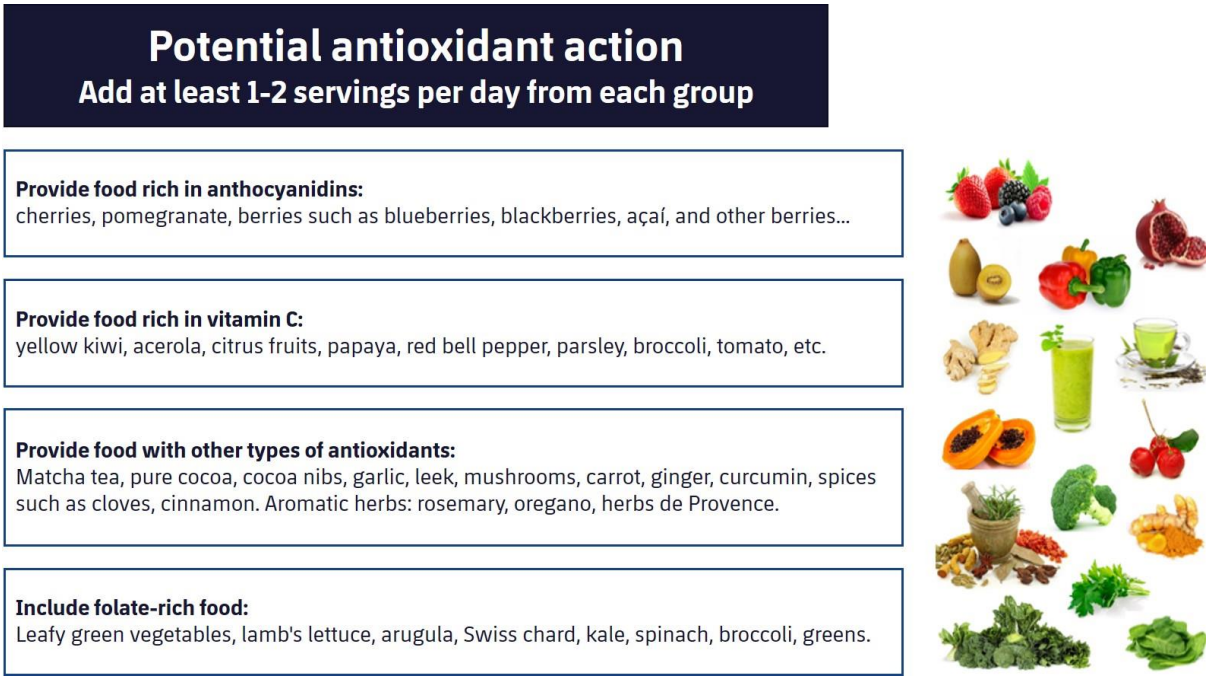
Micronutrients

Apart from vitamins B12, B9 and magnesium, we should highlight vitamin D, and iron which are the ones that tend to show the most deficient values in the analyses.

But we cannot solely focus on macronutrients and micronutrients. Nutrition is much more than just carbohydrates, proteins, and iron. In the small things, we find big differences, and nutrition quality is essential for athletes.

In addition to vitamins and minerals, significant amounts of phytonutrients with antioxidant properties and inflammation-modulating substances will also be crucial for regeneration and recovery.

Image 16: Boosting Antioxidant Action



Source: prepared by the authors.

Potencial acción antioxidantes	Potential antioxidant action
Añade mínimo 1-2 al día de cada grupo	Add at least 1-2 servings per day from each group
Aportar alimentos con antocianidinas: cerezas, granada, frutos rojos: arándanos, moras, açaí y otras bayas...	Provide food rich in anthocyanidins: cherries, pomegranate, berries such as blueberries, blackberries, açaí, and other berries...
Aportar alimentos con vitamina C: kiwi amarillo, acerola, cítricos, papaya, pimiento rojo, perejil, brócoli, tomate, etc.	Provide food rich in vitamin C: yellow kiwi, acerola, citrus fruits, papaya, red bell pepper, parsley, broccoli, tomato, etc.
Aportar alimentos con otros tipos de atioxidantes	Provide food with other types of antioxidants

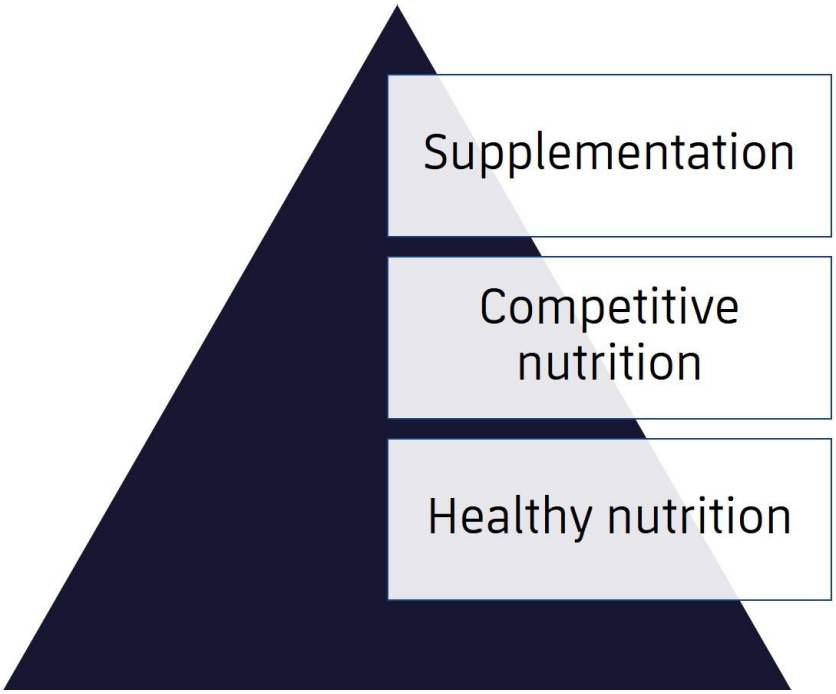
Té macha, cacao puro, nibs de cacao, ajo, puerro, setas, zanahoria, jengibre, cúrcuma, especias: clavo, canela. Hierbas aromáticas: romero, orégano, hierbas provenzales	Matcha tea, pure cocoa, cocoa nibs, garlic, leek, mushrooms, carrot, ginger, curcumin, spices such as cloves, cinnamon. Aromatic herbs: rosemary, oregano, herbs de Provence.
Aportar alimentos atlos en folatos	Include folate-rich food
Verduras de hoja verde, canónigos, rúcula, acelgas, kale, espinacas, brócoli, greens.	Leafy green vegetables, lamb's lettuce, arugula, Swiss chard, kale, spinach, broccoli, greens.

To ensure a high intake of antioxidants, aim to incorporate 1 or 2 types of food from each group per day.

Unit 3.6 Supplementation and Ergogenic Aids

In the world of elite sports, to achieve the best performance from athletes, especially during periods of high match load, stress, and fatigue, it may be beneficial to complement a quality diet with ergogenic supplements that can enhance the player's performance.

Image 17: Basic Nutrition Pyramid



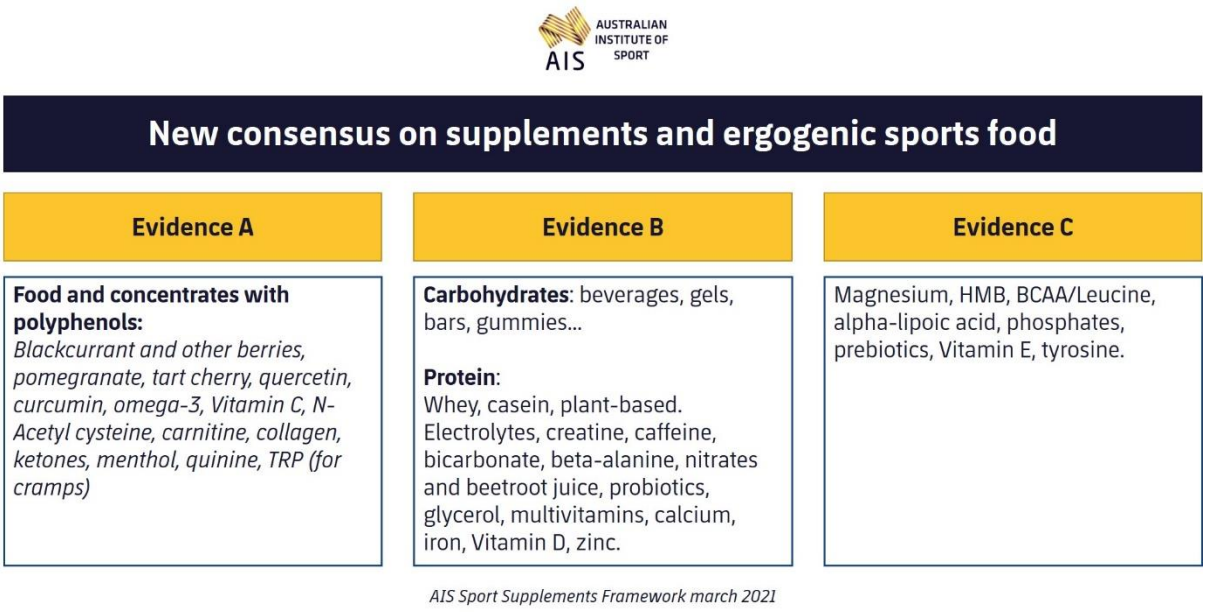
Source: prepared by the authors.

Suplementación	Supplementation
Alimentación competitiva	Competitive nutrition
Alimentación saludable	Healthy nutrition

3.6.1 Scientific Evidence and Types of Supplements

To do so, we need to rely on scientific evidence. What types of substances have been shown to be important in sports? For the answer, we refer to the consensus of the International Olympic Committee 2018 and the consensuses of the Australian Institute of Sport (AIS) from 2019 and the most recent update published in 2021, which is summarized in the following infographic.

Image 18: Infographic



Source: prepared by the authors based on Australian Institute of Sport, 2019.

Nuevo consenso sobre suplementos y alimentos deportivos ergogénicos	New consensus on supplements and ergogenic sports food
Evidencia	Evidence

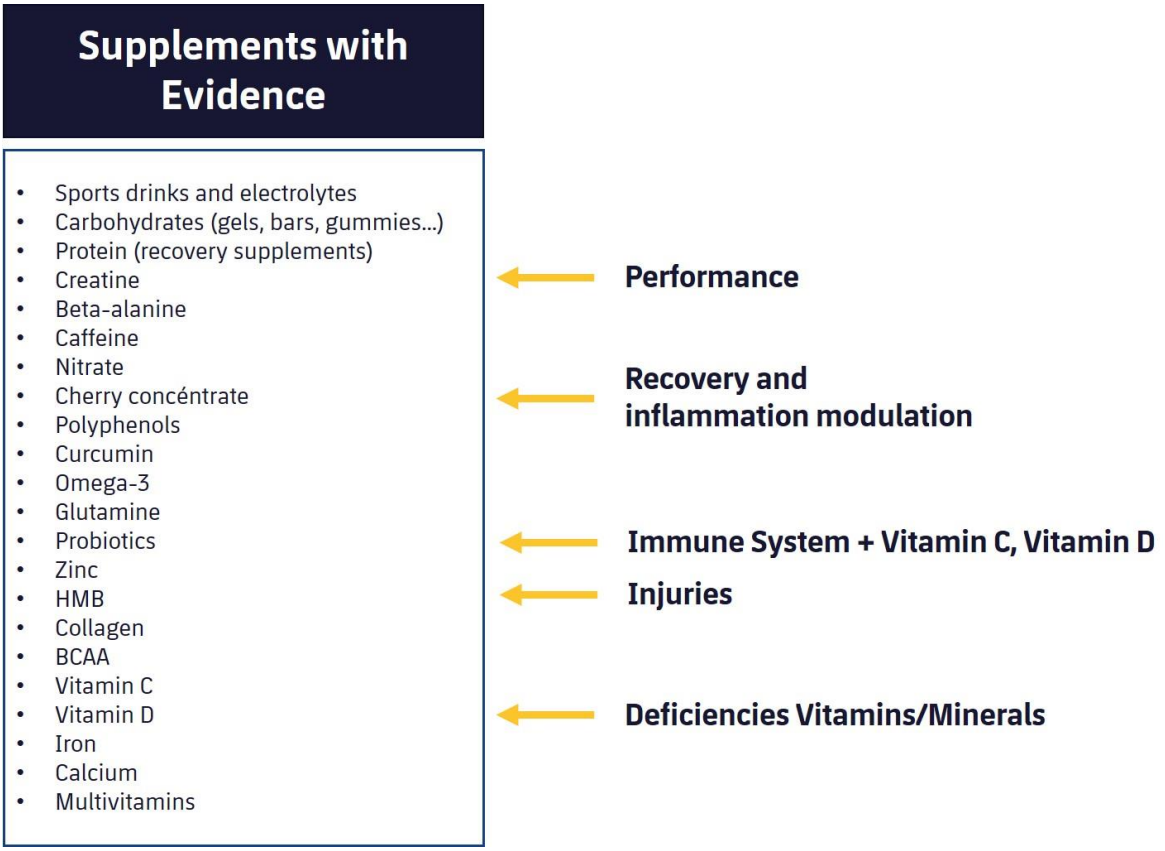
Alimentos y concentrados con polifenoles: backcurrant y otras bayas, granada, cereza ácida, quercetina, curcumina, omega-3, Vit C, N-Acetil cisteina, carnitina, colágeno, cetonas, mentol, quinina, TRP (p. calambres)	Food and concentrates with polyphenols: blackcurrant and other berries, pomegranate, tart cherry, quercetin, curcumin, omega-3, Vitamin C, N-Acetyl cysteine, carnitine, collagen, ketones, menthol, quinine, TRP (for cramps)
CH: bebidas, geles, barritas, gominolas... Proteína: suero, caseína, vegetales. Electrolitos, creatina, cafeína, bicarbonato, beta alanina, nitratos y jugo de remolacha, probiótics, glicerol, multivitamínicos, calcio hierro, VIT D, Zinc.	Carbohydrates: beverages, gels, bars, gummies... Protein: whey, casein, plant-based. Electrolytes, creatine, caffeine, bicarbonate, beta-alanine, nitrates and beetroot juice, probiotics, glycerol, multivitamins, calcium, iron, Vitamin D, zinc.
Magnesio, HMB, BCAA/Leucina, ácido alfa lipoico, fosfatos, prebióticos, VIT E, Tirosina.	Magnesium, HMB, BCAA/Leucine, alpha-lipoic acid, phosphates, prebiotics, Vitamin E, tyrosine.

In the world of football, the most commonly used supplements are the following, as seen in the infographic:

- Carbohydrate intake in the form of sports drinks and gels.
- Whey protein and recovery products with carbohydrate-protein blends.
- Creatine for muscle recovery, among many other benefits.
- Beta-alanine: intracellular buffer that should be periodised during the season.
- Caffeine: optional based on individual tolerances and player's sensations.
- Nitrates: with concentrates and/or food that can help with vasodilation and provide more oxygen to the tissues.
- Aids in modulating inflammation: curcumin phytosome, omega-3.
- Polyphenols from concentrated phytonutrients that can enhance recovery and alleviate DOMS, such as tart cherry, berry concentrates, etc.
- Probiotics: especially during travel and high-stress phases.
- Vitamins and minerals that may be deficient: B-group vitamins (B12, B9), Vitamin D, iron, calcium. Even when higher doses are needed to support the immune system during specific phases, they can be supplemented with vitamin D, zinc, and vitamin C.

- Additionally, specific supplements may be required during injury phases, such as BCAAs and collagen.

Image 19: Supplements with Evidence



Source: prepared by the authors.

Suplementos con evidencia	Supplements with Evidence
Rendimiento	Performance
Recuperación y modulación inflamación	Recovery and inflammation modulation
Sistema. Inmune: + Vit C, Vit D	Immune System + Vitamin C, Vitamin D
Lesiones	Injuries
Déficits. Vitaminas/minerales	Deficiencies Vitamins/Minerals

Bebida deportiva y electrolitos	Sports drinks and electrolytes
CH (geles, barritas gominolas...)	Carbohydrates (gels, bars, gummies...)
Proteína (recuperadores)	Protein (recovery supplements)
Creatina	Creatine
Beta alanina	Beta-alanine
Cafeína	Caffeine
Nitrato	Nitrate
Concentrado de cereza	Cherry concentrate
Polifenoles	Polyphenols
Cúrcuma	Curcumin
Omega-3	Omega-3
Glutamina	Glutamine
Probióticos	Probiotics
Zinc	Zinc
HMB	HMB
Colágeno	Collagen
BCAA	BCAA
Vit C, Vit D	Vitamin C, Vitamin D

Hierro	Iron
Calcio	Calcium
Multivitamínicos	Multivitamins

3.6.2 Safety and Ergogenic Quality

Regardless of the scientific evidence, product quality is essential. We should pay attention to the label, nutritional information, and ingredient list to choose products with a cleaner label. Additionally, it is important to use products with anti-doping certifications that ensure compliance with the regulations of the World Anti-Doping Agency (WADA).

Image 20: Anti-Doping Certification

Source: prepared by the authors.

Conclusions and Nutritional Extension

We are only at the beginning of the match; we need to continue training our knowledge of the physiology of female athletes and sports nutrition; especially, to share the knowledge of our football players with other teams of professionals to approach the second half with more data that allows for individualisation, not only among female football players but also among themselves.

We also need to continue integrating knowledge from other fields and utilising data from new technologies or tests, such as nutrigenetics or new biomarkers. Studying the intestinal and oral microbiota can provide us with additional insights and new nutritional strategies, both in theory and in practice, to win this fascinating match.

Unit 3.7 Sleep and Rest

Introduction

The daily life of a player is filled with demands, commitments, and activities: school, football, family, leisure, events. Sometimes, in order to fulfil all these activities, players "steal" hours of sleep at night. However, we must be aware that sleep is fundamental for our well-being, essential for maintaining health and, thus, quality of life. Sleep is part of our daily routine and is a vital process necessary for the proper functioning of the body to survive. The quantity of sleep can have negative or positive effects on the athlete's health and performance. But it is not just about sleeping enough hours; it is about achieving restful and quality sleep.

The consequences of not sleeping well can be numerous and varied: fatigue, drowsiness, irritability, lack of concentration, slow reflexes, impaired academic and athletic performance. Chronic sleep deprivation increases the risk of injuries, accidents, illnesses, and even death. Therefore, intervening to optimise this habit ensures that we are taking care of the athlete's performance and, above all, their health.

Players should be encouraged to sleep more hours than the general population due to the recovery demands imposed by football physical activity. Sleep has been defined by experts as a good recovery strategy due to its physiological and restorative effects.

Let's start by discussing the unique biological differences of women. The menstrual cycle, pregnancy, and menopause affect the way women sleep and its quality (Regal, 2009). According to recent studies, women may need more hours of sleep than men (Horne, J. 2018), and these differences begin in puberty. One of the main reasons for this is the changing levels of hormones throughout the month and throughout their lives. The sleep-wake cycles are regulated by the hormone's oestrogen and progesterone, and since these levels are constantly changing, they affect circadian rhythms, hence the greater need for sleep. Other conditions such as anxiety and depression are nearly twice as likely to affect women compared to men, and these illnesses are strongly related to insomnia.

We then explain what happens to women at certain moments of their cycle. During menstruation, women may experience difficulty sleeping due to headaches, fluid retention, cramps, feeling more tired and fatigued, and increased daytime sleepiness. In

the case of women with severe premenstrual syndrome, they also experience these same described symptoms, which have consequences for the quality and quantity of sleep.

During pregnancy, women may develop restless legs syndrome, a condition that makes it more difficult to fall asleep (causing uncomfortable sensations in the legs, such as itching, pulling, or crawling sensations. These sensations create an overwhelming need to move the legs). They are also more prone to experience depression, sleep apnoea, pain, and incontinence, which disrupt their sleep. These sleep problems can persist in the postpartum period when their hormone levels decrease while they begin to care for a newborn with an irregular sleep cycle. This often results in even more daytime sleepiness and poor sleep quality.

In menopause, hot flashes and temperature changes disrupt sleep. In addition, there is a higher risk of developing sleep apnoea (a sleep disorder that causes pauses in breathing and can interfere with sleep quality, even if the person does not wake up), which is manifested as excessive sleepiness and daytime fatigue (Regal et al., 2009).

Studies show that women spend more time in deep sleep and fall asleep faster than men. This may indicate that women have a greater need for sleep, although it can vary during certain phases of the menstrual cycle, such as during menopause (taking longer to fall asleep and having less time in deep sleep). According to a study conducted by the University of Pennsylvania (Ragini, 2013), the female brain structure allows for the development of certain skills, such as analytical and intuitive abilities, communication, social cognition, and memory, qualities that equip women for multitasking and group problem-solving, which require a greater need for rest to recover from daily mental activity.

Understanding the effects that hormones have at different times of the month and throughout a woman's life stages, as well as considering lifestyle and environmental factors, can help us understand and optimise the sleep quality of our players.

What happens while we sleep?

Sleep is a combination of physiological and behavioural states.

> Sleep is a state of uniform rest characterised by low levels of physiological activity, including decreased heart rate, blood pressure, and respiratory rate, as well as reduced responsiveness to external stimuli. Its purpose is to provide restorative effects and allow for regeneration and stabilisation of organic functions, which are essential for human beings (Medina, 2012). (Ledezma et al., 2015, p. 17).

It has also been defined as "physical and mental rest during which a person undergoes a relatively inactive and unconscious state associated with recovery processes and

involved in numerous biological functions" (Caia, Halson, Scott, & Kelly, 2017) (Mata et al., 2018, p. 2).

Sleep not only serves to alleviate sleepiness. During the night, the brain continues to work and keeps our vital functions, such as breathing, digestion, and circulation, functioning. Additionally, while we sleep, there are changes in the functioning of our body and brain to prepare us for the new day.

During sleep:

- The brain organises the information it has learned during the day and consolidates it into memory and cognitive function.
- Growth hormone (GH) is released, which helps repair tissues and muscles, allowing them to recover from the day's activities and efforts.
- Cells are repaired, and waste substances that accumulate during daytime functioning are eliminated.
- Sleep favours energy and molecular balance, aiding in cell repair and controlling the body's energy usage.
- It maintains the optimal functioning of our immune, endocrine, and metabolic systems.
- Heart rate, blood pressure, and respiratory frequency are regulated, which are important processes for cardiovascular health.
- Sleep promotes emotional balance, reducing mood swings and irritability.

> A decrease in these sleep recommendations can compromise performance in athletes (Cheikh et al., 2018). Thus, insufficient sleep has been shown to reduce physical capacity, increase perceived exertion, and decrease mood (Oliver, Costa, Walsh, Laing & Bilzon, 2009). (Mata et al., 2018, p. 3).

Furthermore, quality sleep reduces the risk of injuries and illnesses. The evidence shows that although athletes consider sleep important for their recovery and performance, various studies indicate that they sleep fewer hours than what is considered necessary, and the quality of sleep is inadequate. The negative effects of sleep deprivation affect athletes in many sports tasks that require maximum alertness (reading the game and predicting opponents' movements), attention and concentration (needed for receiving a pass from a nearby teammate), recovery from training and matches fatigue, and aggression and irritability on the field.

There is a great intra- and inter-individual variability in the sleep quality of players, but several studies demonstrate how athletes' express difficulties in falling asleep, daytime fatigue, and a prevalence of less than 7 hours of night-time sleep.

In sports in general, but especially in high-performance sports, where physical and psychological stress coexist due to a heavy load of training and matches, changes in training and match schedules, pressure for results, and the impact of social media, difficulties in athletes' sleep and rest are intensified. Therefore, sleep emerges as a determining factor in the health and performance of athletes, particularly considering that women have a higher prevalence of sleep-related problems.

Stages of Sleep

Throughout the night, we go through multiple cycles of REM and non-REM sleep. Each cycle lasts approximately 90 minutes, with adults experiencing 4-6 cycles per night and children having 6-10 cycles, depending on their age.

Deep sleep is more predominant in the first part of the night, while REM sleep dominates the second part.

Let's explain the phases of sleep:

Non-REM Sleep

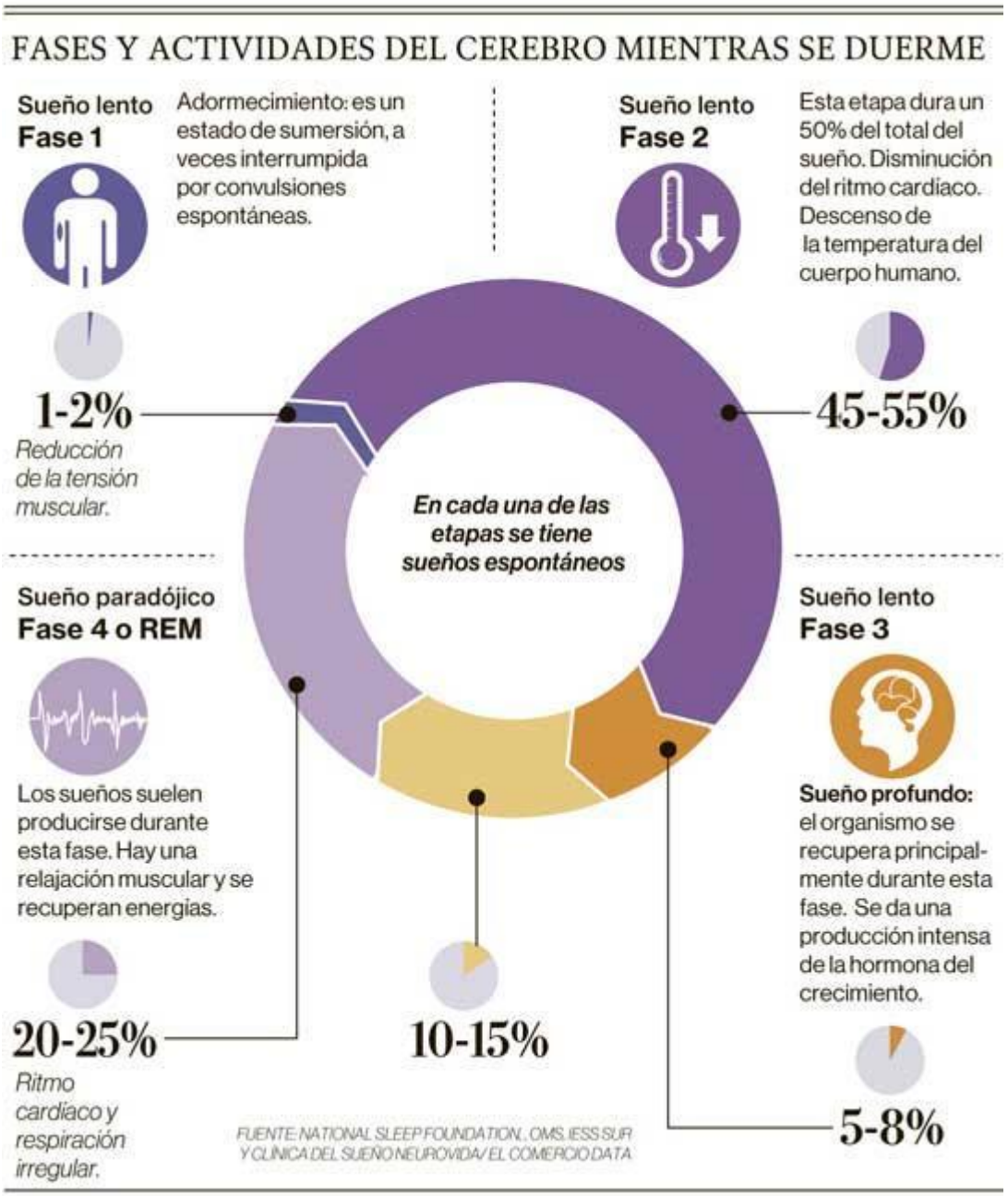
This is sleep characterised by slow brain waves and is divided into 4 stages:

1. "Stage 1 Drowsiness: This is the transition between wakefulness and sleep, where eye movements slow down, and muscle activity decreases. This stage accounts for about 5-10% of total sleep time (Microbiota and bienestar, 2022, https://www.microbiotaybienestar.es/fases-del-sueno-sucede-cada-una/).
2. Stage 2 Light Sleep: Heart rate and respiratory rate decrease, and there are mild eye movements. This stage combines periods of high brain activity with periods of lower intensity, making it difficult to wake up when in this stage. It lasts approximately 45-50% of our sleep cycles (Microbiota y bienestar, 2022).
3. Stage 3 Transition to Deep Sleep: This is the path to deep sleep and lasts 2-3 minutes. Growth hormone is secreted during this phase (Microbiota y bienestar, 2022).
4. Stage 4 Deep or Slow-Wave Sleep: This phase determines the quality of sleep, whether it is restorative or not. Respiratory and arterial rates decrease, and it usually accounts for 15% of total sleep time (Microbiota y bienestar, 2022).

REM Sleep (Rapid Eye Movements) or Paradoxical Sleep Stage

This is the phase in which we dream and process external information. Brain activity is high, similar to when we are awake. Eye movement, heart rate, and blood pressure increase. REM sleep occupies 25% of our sleep cycle (Microbiota and bienestar, 2022).

Image 21: Stages of Sleep

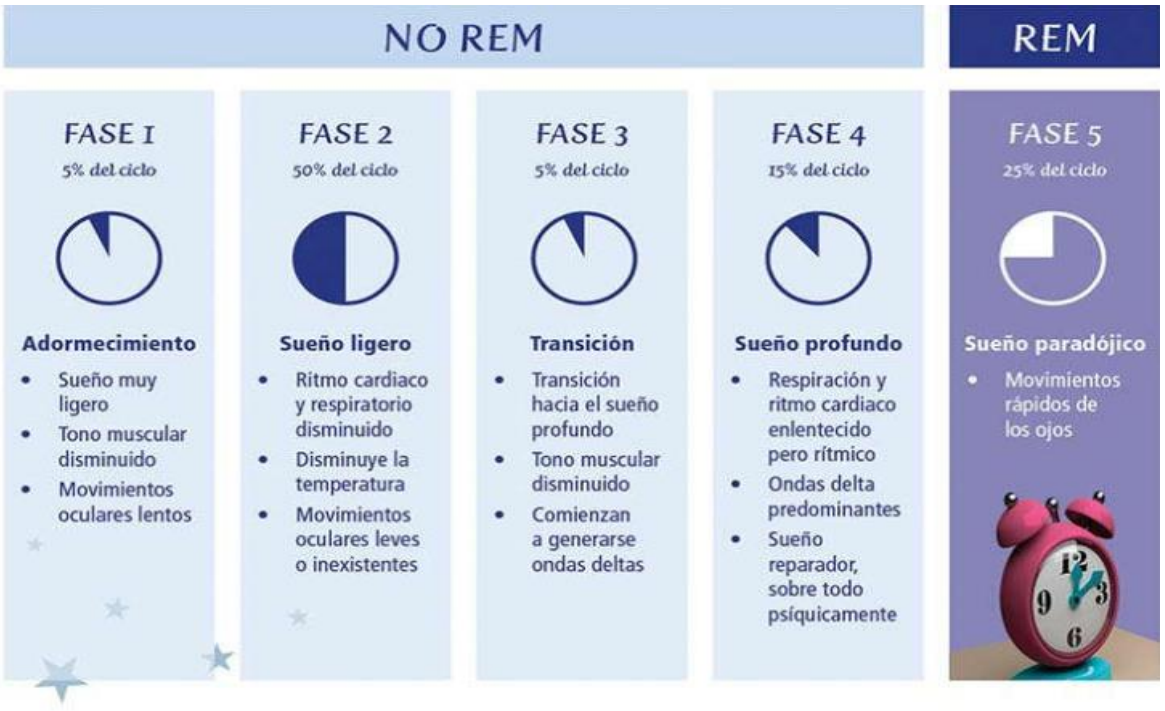


Source: [Untitled image about phases of sleep]. (n.d.). https://bit.ly/3tlQcoD

Fases y actividades del cerebro mientras se duerme	Stages and Brain Activities During Sleep
Sueño lento	Slow Wave Sleep:

Adormecimiento: es un estado de sumersión, a veces interrumpida por convulsiones espontáneas	Drowsiness: It is a state of submersion, sometimes interrupted by spontaneous convulsions.
Fase	Stage
Reducción de la tensión muscular	Muscle tension reduction.
Sueño paradójico	Paradoxical Sleep
Los sueños suelen producirse durante esta fase. Hay una relajación muscular y se recuperan energías	Dreams usually occur during this stage. There is muscle relaxation and energy recovery.
Ritmo cardíaco y respiración irregular	Heart rhythm and irregular breathing
En cada una de las etapas se tiene sueños espontáneos	Spontaneous dreams occur in each of the stages.
Sueño lento	Slow Wave Sleep
Esta etapa dura un 50% del total del sueño. Disminución del ritmo cardíaco. Descenso de la temperatura del cuerpo humano.	This stage accounts for 50% of total sleep time. Decreased heart rate. Decrease in body temperature.
Sueño profundo: el organismo se recupera principalmente durante esta fase. Se da una producción intensa de la hormona del crecimiento-	Deep Sleep: The body primarily recovers during this stage. There is an intense production of growth hormone.

Image 22: Non- REM- REM Sleep



Source: Microbiota y bienestar, 2022, https://acortar.link/tKZfOf

No REM	Non-REM
REM	REM
Fase	Stage
5% del ciclo	5% of the cycle
Adormecimiento	Drowsiness
Sueño muy ligero Tono muscular disminuido Movimientos oculares lentos	Very light sleep Decreased muscle tone Slow eye movements
Sueño ligero	Light sleep

Ritmo cardíaco y respiratorio disminuido Disminuye la temperatura Movimientos oculares leves e inexistentes	Decreased heart and respiratory rate Decrease in temperature Light or absent eye movements
Transición	Transition
Transición hacia el sueño profundo Tono muscular disminuido Comienzan a generarse ondas deltas	Transition to deep sleep Decreased muscle tone Delta waves start to generate
Sueño profundo	Deep sleep
Respiración y ritmo cardíaco enlentecido pero rítmico. Ondas delta predominantes Sueño reparador, sobre todo psíquicamente.	Slowed but rhythmic breathing and heart rate Predominant delta waves Restorative sleep, especially for the mind.
Sueño paradójico	Paradoxical Sleep
Movimientos rápidos de los ojos	Rapid eye movements

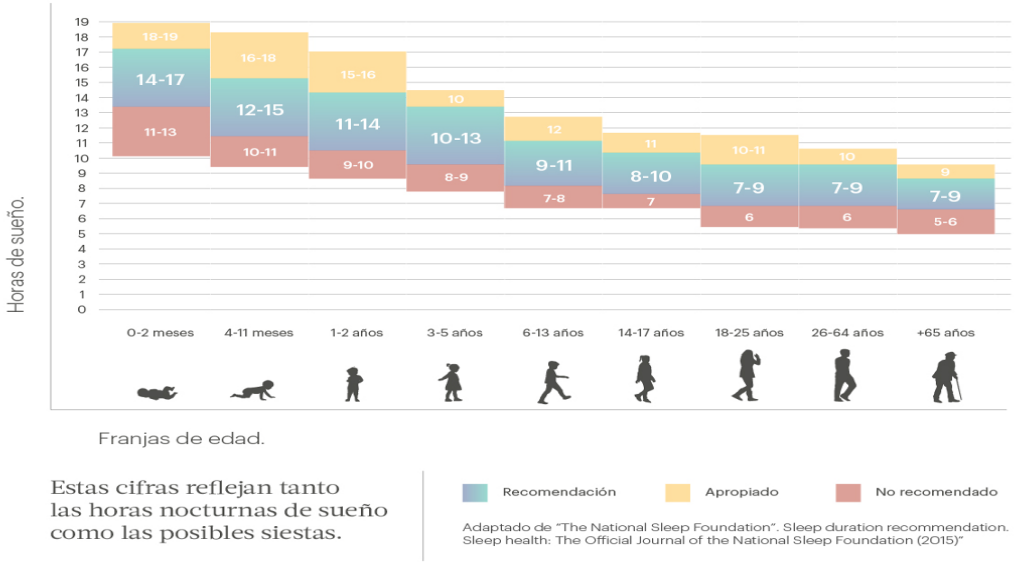
How Many Hours Do We Need to Sleep?

The need for night-time sleep depends on age, health status, emotional state, and daily activity of an individual.

When we are younger, we need more hours of sleep, and these hours decrease as we grow older. However, we could consider that, starting from puberty, the recommended hours should not be less than 8, especially considering the hours of football practice.

Here are the recommended hours of sleep according to the age group the player belongs to:

Image 23: Hours of Sleep Based on Age



Source: [Untitled image about hours of sleep based on age]. (n.d.). https://bit.ly/3zrgoBU

Horas de sueño	Hours of sleep
Meses	Months
Años	Years
Franjas de edad	Age groups
Estas cifras reflejan tanto las horas nocturnas de sueño como las posibles siestas	These figures reflect both night-time sleep hours and possible naps.
Recomendación	Recommendation
Apropiado	Appropriate
No recomendado	Not recommended

Due to their lifestyle, young girls may experience sleep disturbances and disruptions to their sleep regulation system. We pay special attention to the young age group. There is a trend among teenage girls related to decreased sleep hours on weekdays and compensating for it at weekends. We are all familiar with that player who sleeps for 5-7 hours from Sunday to Friday, but then spends an average of 10-12 hours in bed at the weekend, going to bed late and waking up at lunchtime. This behaviour is not exclusive to teenagers; it is also a recognised pattern in later stages. However, all these behaviours have different consequences, such as decreased academic and athletic performance. But what is most concerning is that the adolescent stage is when lifestyle habits are established, and if not modified as soon as possible, they will have negative consequences for the athlete's health. Attempting to compensate for sleep hours at the weekend does not eliminate the harmful effects of accumulated sleep deprivation in the body.

This trend of delaying bedtime is associated with a variation in the circadian rhythm (a cyclic pattern of sleep that automatically regulates our tendency to activate or deactivate, associated with sunlight), and social jet lag occurs. Social jet lag is defined as sleep deprivation caused by the use of technology and screens for maintaining social networks, resulting in a delayed bedtime. It has the same effects as international travel jet lag: fatigue, memory lapses, confusion in decision-making, and irritability. For athletes, having lower quality and quantity of sleep also affects muscle fatigue and cognitive performance in the game: spatial ability is reduced, and decisions are made more slowly in both game comprehension and execution, increasing the likelihood of mistakes.

Factors that Affect the Sleep of Athletes:

Sleep is considered by some experts as one of the best recovery strategies due to its physiological and restorative effects. Adequate sleep has been identified as the new frontier in improving athletic performance (Halson & Juliff, 2017). (Mata et al., 2018, p. 3).

For this reason, it is crucial to understand the factors that affect the sleep of our athletes, as well as the strategies to promote optimal sleep hygiene.

There are various internal and external factors that can negatively affect sleep quality (Mata et al., 2018): travel, consumption of caffeine or other stimulants, training and competition schedules, stress during the day, performance anxiety, screen use, training volume, transfers and trips, among others. Next, we will discuss the most relevant factors:

1. Psychosocial stress of the player: both stress and anxiety have a negative influence on sleep. Competition pressure, pre-game nerves, and performance concerns predict poor sleep quality prior to a match. The athlete's ability to cope with these situations is important for improving sleep before competing (Mata et al., 2018). It is also important to consider the player's exposure to other factors, such as social

media, balancing other areas of life (studies, family, leisure), which can affect psychosocial stress and, in turn, their rest and daily sleep.

2. Timing of sporting events: the most common training sessions occur late at night, which tends to result in athletes having dinner late, going to bed later, and experiencing high levels of excitement, delaying sleep latency compared to days without training or when the match is scheduled earlier in the day (Mata et al., 2018).

Travel and journeys: players constantly travel on national and international trips, which involve changes in time zones, altitude, noise, and travel-related stress (packing, finalising details). Long-distance travel has shown negative effects on sleep (Mata et al., 2018). Regarding jet lag, it is defined as the desynchronisation of the biological rhythms governing the body due to disruptions in sleep and meal schedules resulting from crossing multiple time zones during travel. To minimise jet lag, it is important to adapt as soon as possible to the sleep schedule of the destination. It is advisable not to sleep or sleep as little as possible until reaching the destination in order to adjust the schedule and meals, facilitating the establishment of a new routine according to the local time at the destination. Another possible option is the consumption of melatonin under medical control before the trip, staying active and taking walks during the journey, drinking water frequently, and using compression stockings to improve blood circulation.

3. Rest environment: having control over familiar conditions reduces uncertainty and promotes a relaxed state for sleep induction. This is known as the first-night effect (FNE). When we travel, the rooms, beds, pillows, and surroundings are unfamiliar, which can affect our rest. Ensuring some familiar conditions, such as bringing our own pillow, maintaining a routine schedule, and having teammates with similar routines, can help promote sleep. For organizations and clubs, staying at the same hotels or travelling a couple of nights earlier can be considered facilitators as they provide some familiarity with the destination, aiding in adaptation and reducing the body's vigilance levels. It has been observed that the effects of hyper vigilance from FNE disappear on the second night.
4. Use of screens and electronic devices: The use of devices is associated with poorer sleep quality, daytime fatigue, and increased sleep latency. The bright light emitted by devices reduces melatonin production, increasing alertness and signalling the brain that it is not time to sleep. When combined with social media use, it has been shown to increase stimulation and emotional excitement. There is a strong negative relationship between the use of electronic devices and sleep quality (Mata et al., 2018).
5. Consumption of stimulating substances (caffeine): Caffeine is a substance commonly consumed by athletes to improve performance, as it increases their state of alert and, when consumed in moderation, provides an optimal level of

concentration. However, it can interfere with sleep quantity and quality (Mata et al., 2018).

6. Chronotype (the biological clock that determines whether individuals prefer and are more active in the morning or at night). This chronotype has a significant influence on athletic performance. Therefore, knowing whether one is a morning "lark" (with a preference for morning mental and physical performance) or a night "owl" (with greater night-time physical and mental activation) can have a significant impact on daily performance and competition results. Seeking circadian advice to work on aligning the player's chronotype with the demands of football can enhance performance.
7. In the case of injured players, increase the number of hours. Between 9 and 10 hours of sleep enhances tissue regeneration and recovery. Furthermore, it is recommended to go to bed between 10:00 PM and 11:30 PM and wake up between 7:30 AM and 8:30 AM, as the hormonal system secretes growth hormone and testosterone, which aid in this regeneration.

Understanding these factors will facilitate the implementation of different action plans for the athlete, which can be carried out by professionals responsible for the player's health and performance. An important point to consider is the particularisation and individualisation of these factors, as each organism acts independently and varies according to the environment and circumstances it is experiencing.

Sleep hygiene

All measures aimed at achieving quality sleep that allows for proper rest are referred to as sleep hygiene. Being able to create and implement measures that facilitate increased sleep hours and its quality should be an objective for the players themselves and for professionals working in the sports environment. The implementation of these strategies is not meant for the day before competition but for the athlete's daily routine (Mata et al., 2018).

Recommendations according to Mata et al. (2018):

- Establish a bedtime and wake-up routine. Try to maintain it at weekends as well.
- The bed is only for sleeping: associate the bed with a place for rest and relaxation. Avoid playing, studying, or any other activity that is not restful.
- Have a light dinner (about 2 hours before bedtime), avoid liquids and energising or stimulating beverages. Include food that promote improved sleep quality.
- Avoid the use of technology and screens before bed (1 hour before).
- If you take a nap, make sure it does not exceed 20-30 minutes. Napping aids in recovery between training sessions and competitions. Naps are recommended in the early afternoon, as getting closer to bedtime can make it difficult to fall asleep or cause interruptions.

- The bed is only for sleeping: do not think about your problems in bed. Use meditation and relaxation techniques to induce sleep.
- Create a relaxing routine before bedtime. For example, have an herbal tea or visualise relaxing things. Establish mental deactivation and relaxation routines before going to bed, such as mindfulness, reading, soothing music, taking a warm bath, and stretching.
- Take advantage of sunlight during the day to stimulate serotonin production in your brain, which will aid in the subsequent secretion of melatonin, the sleep hormone.

  Pay attention to the environment where you sleep: room temperature (between 18-22°C), no noise, no light; comfortable bed, pillow, and bedding.

Images 24 and 25: Infographic

Source: prepared by the authors.

Cómo puedes dormir major	How to sleep better
Recomendaciones generals	General Recommendations
Atención al lugar donde duermes	Pay attention where you sleep
Tu cama es solo para dormís. Si la usas para leer, jugar tumbado en ella, estudiar, a cualquier otra actividad, te será más difícil relacionarla con la relajación y el descanso.	Your bed is only for sleeping. If you use your bed for reading, playing, studying, or any other activity, it will be harder for you to associate it with relaxation and rest.
Tu habitación debe ser silenciosa, fresca (entre 18 y 22° C de temperatura) y sin excesiva luz	Your bedroom should be quiet, cool (between 18 and 22°C), and without excessive light.
El colchón debe ser rígido hipoalergénico y transpirable. La almohada debe	The mattress should be firm, hypo-allergenic, and of breathable fabric. The

mantener la posición natural de la columna	pillow should maintain the natural position of the spine.
Adopta rutinas que te ayuden a dormir	Adopt routines that help you sleep.
Repite tu rutina de sueño: misma hora de acostarse y de despertar, incluso los fines de semana. Tus procesos biológicos deben adaptarse al ciclo circadiano para evitar trastornos del sueño y problemas de salud.	Stick to your sleep routine: go to bed and wake up at the same time, even at weekends. Your biological processes should adapt to the circadian cycle to avoid sleep disorders and health problems.
La alimentación y la bebida	Food and drink
Por la tarde, ni refrescos ni bebidas energéticas o estimulantes. Activan el sistema nervioso y el cardiovascular durante horas. Te costará conciliar el sueño.	In the evening, avoid sodas, energy drinks, or stimulants. They activate the nervous and cardiovascular systems for hours, making it difficult for you to fall asleep.
Las cenas, ligeras. Los alimentos con muchas proteínas se difieren lentamente y obligan a tu cuerpo a digerir y dormir a la vez	Have light dinners. Food high in protein are digested slowly and make your body work on digestion while trying to sleep.
No bebas mucho líquido antes de acostarse.	Do not drink too much liquid before going to bed.
Evita el alcohol y el tabaco	Avoid alcohol and tobacco.
La tecnología fuera de la cama	Technology should be used out of the bed.
La tableta, el móvil y la televisión deben estar lejos de tu almohada, y mejor fuera de tu habitación. Las pantallas prohibidas 30 minutos antes de ir a dormir	Tablets, phones, and TVs should be kept away from your pillow and preferably out of your bedroom. Avoid screen 30 minutes before going to bed.

Los problemas fuera de la cama también	Keep problems out of bed too.
Planifica lo que harás al día siguiente, prepara la mochila, la ropa y el resto de las cosas, y practica ejercicios de mediación, relajación o visualización	Plan what you will do the next day, prepare your backpack, clothes, and other things, and practice meditation, relaxation, or visualisation exercises.
Tres hábitos que te ayudarán mucho	Three habits that will help you a lot.
1. Estar al sol al menos una hora al día.	1. Spend at least one hour in the sun each day.
Nuestro cerebro generará serotonina, sustancia que ayuda a nuestro estado de ánimo, sincronizará mejor su ciclo circadiano, y también producirá mejor la melatonina.	Our brain will generate serotonin, a substance that helps improve our mood, better synchronise our circadian cycle, and also promote the production of melatonin.
2. Evita las siestas largas	2. Avoid long naps.
No deben superar los 20/30 minutos. No la duermas nunca después de las 16 horas.	They should not exceed 20-30 minutes. Never take a nap after 4 PM.
3. Reduce tu temperatura corporal	3. Lower your body temperature.
Una ducha templada antes de dormir acerca tu cuerpo a la temperatura ideal para dormir.	Taking a warm shower before bedtime brings your body closer to the ideal temperature for sleep.
Mejora la calidad de tu sueño mediante la alimentación	Improve sleep quality through nutrition.
Hay alimentos a evitar, y otros recomendables, antes de ir a dormir. También influye el modo de cocinarlos y el horario de las comidas	There is food to avoid and other recommended before going to bed. The cooking method and meal timing also play a role.

Sigue una dieta variada y equilibrada	Follow a varied and balanced diet.
Debe ser rica en verduras, frutas, legumbres, cereales integrales, pescados, lácteos, huevos y carnes blancas. Para cocinar, elije aceite de oliva, y grasas saludables como las que se obtienen de los frutos secos naturales, las semillas, el aguacate y el pescado azul	It should be rich in vegetables, fruit, legumes, whole grains, fish, dairy products, eggs, and lean meat. Choose olive oil and healthy fats from nuts, seeds, avocado, and oily fish for cooking.
Establece una rutina de alimentación	Establish an eating routine.
Haciendo tus comidas siempre a la misma hora favorecerás la regulación de tu ritmo circadiano. Hazlo también los fines de semana.	By having meals at the same time every day, you promote the regulation of your circadian rhythm. Do this at weekends as well.
Distribuye la cantidad de alimentos	Distribute the amount of food.
Recuerda, la cena siempre tiene que se más ligera que la comida.	Remember, dinner should always be lighter than lunch.
Toma vitaminas del grupo B	Take B-group vitamins.
Mejoran el funcionamiento del metabolismo y facilitan el sueño. Están en los vegetales de hoja verde, la soja, los cereales integrales, las legumbres, las setas, los frutos secos, los quesos curados, la carne de cerdo, el pescado, el marisco, las viceras, el plátano y el aguacate.	They improve metabolic function and facilitate sleep. They can be found in leafy green vegetables, soy, whole grains, legumes, mushrooms, nuts, aged cheese, pork, fish, shellfish, organ meat, bananas, and avocados.
No retrases la cena	Do not delay dinner.

Debes cenar de forma ligera, entre 1 y 2 horas antes de ir a dormir para que la digestión no interrumpa tu descanso	Have a light dinner between 1 and 2 hours before going to bed so that digestion does not interrupt your rest.
Vigila como están cocinados los alimentos	Pay attention to how food is cooked.
Las cosas, hechas a la plancha, al vapor, al horno y salteados con un poco de aceite, tipo wok, hacen mas fácil tu digestión.	Grilled, steamed, baked, and lightly sautéed with a little oil, such as stir-frying, make digestion easier.
Come despacio	Eat slowly
Sobre todo mastica lentamente y así digerirás mejor y más rápido	Especially chew slowly to have a better and faster digestion.
Bebidas energizantes y estimulantes, prohibidos 4 horas antes	Avoid energising and stimulating drinks 4 hours before bed.
Cuatro horas antes de irte a dormir no deberías tomar café, té, refrescos de cola, guaraná ni bebidas energizantes aquellas que contienes taurina, guaraná y cafeína.	Four hours before going to bed, you should not consume coffee, tea, cola drinks, guarana, or energy drinks containing taurine, guarana, and caffeine.
Cuidado con los productos indicados para deportistas	Be cautious with products intended for athletes.
Geles energizantes, bebidas y otros, pueden contener productos estimulantes. Lee atentamente las etiquetas para que no interfieran en tu descanso nocturno	Energy gels, drinks, and others may contain stimulating substances. Read the labels carefully to ensure they do not interfere with your night-time rest.
Evita las cenas abundantes, con mucha grasa, azúcar, o que dan gases.	Avoid heavy dinners with high fat, sugar, or gas-producing food.

Nada de fritos, rebozados, guisos, otros platos con grasa. Las verduras crucíferas dan acidez y gases: rúcula, brócoli, coles de Bruselas, repollo, col rizada, rábano, grelo y nabo. También debes evitar la menta, los picantes, el vinagre, y las especias. Y el azúcar de caramelos, chicles y alimentos edulcorados.	Avoid fried food, breaded dishes, stews, and other dishes high in fat. Cruciferous vegetables can cause acidity and gas: arugula, broccoli, Brussels sprouts, cabbage, kale, radish, turnip greens, and turnip. Also avoid mint, spicy food, vinegar, and spices. And avoid the sugar found in candies, chewing gum, and sweetened food.

Techniques that Enhance Relaxation

Along with practising good sleep hygiene, it is necessary to introduce techniques that promote a state of calm and relaxation in our body and mind to invite sleep to come and ensure deep and restorative sleep.

It is important to practise these techniques daily, either individually or in combination. Like in sports, training them will help automate them into our daily routine, at the same time, before bedtime, and after digestion.

- Progressive muscle relaxation: Work on tensing and relaxing all parts of our body to deactivate them. Go through all areas from head to toe, paying full attention to each area. Repeat the tension-relaxation exercise three times for each muscle group to achieve total relaxation.

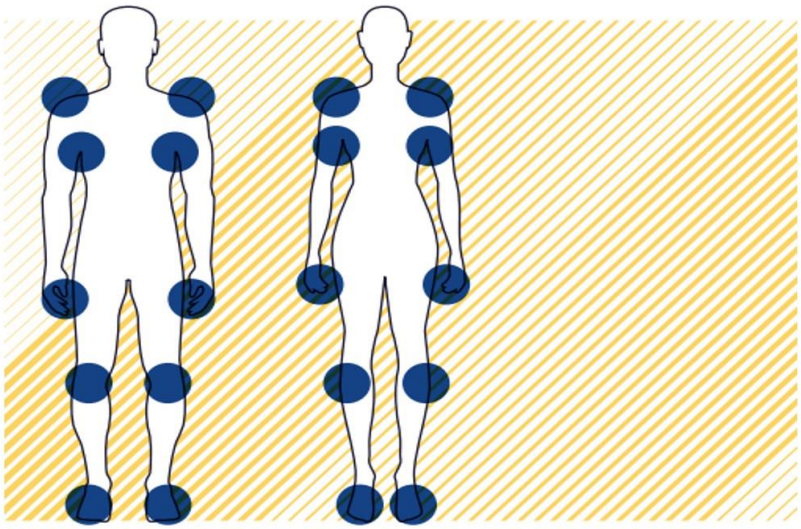
Image 26. Techniques that enhance relaxation

Techniques that enhance relaxation

Technique 1

Relax your body by zones

When lying on your bed, close your eyes and focus on each of the highlighted areas in the image. Start with your shoulders and move downwards to your feet. Notice the tension and feel how each point relaxes, loosens, and releases. Repeat if necessary, in the areas that feel more tense.



Source: prepared by the authors.

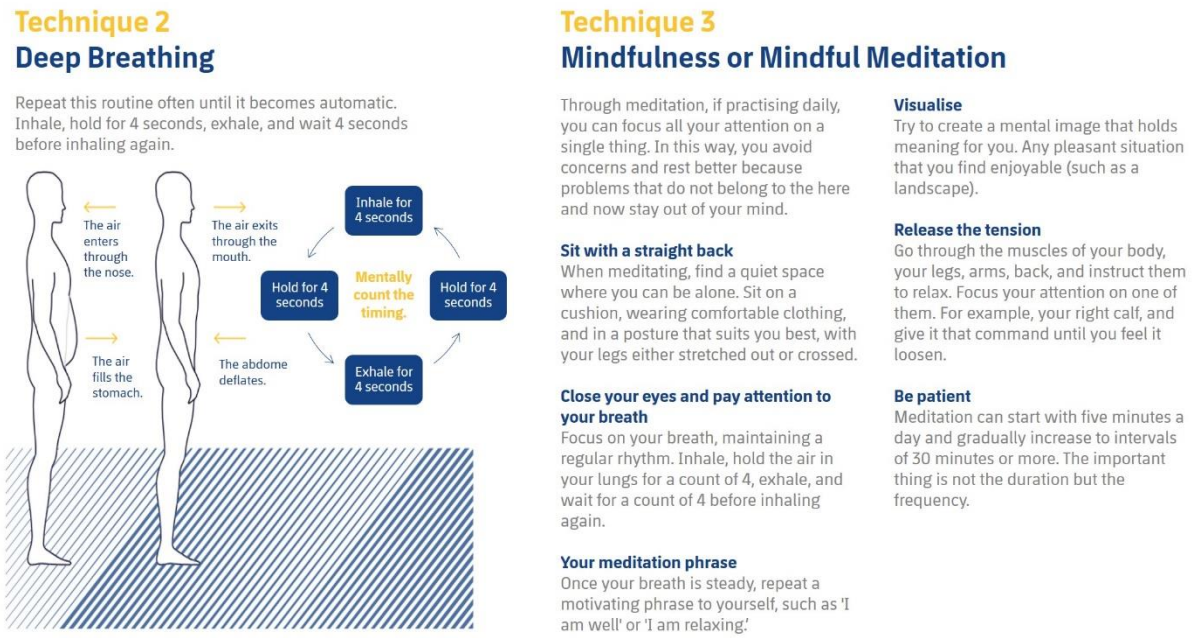
Técnicas que favorecen el descanso	Techniques that enhance relaxation
Técnica 1	Technique 1
Relaja tu cuerpo por zonas	Relax your body by zones
Cundo estés tendido en tu cama, cierra los ojos y concéntrate en cada una de las zonas marcadas de la figura. Comienza por los hombros y sigue hacia abajo, hasta tus pies. Nota la tensión y siente como cada punto se va relajando, destensando, abandonado. Repasa si es	When lying on your bed, close your eyes and focus on each of the highlighted areas in the image. Start with your shoulders and move downwards to your feet. Notice the tension and feel how each point relaxes, loosens, and releases.

necesario hacerlo en las partes que sientas más cargadas.	Repeat if necessary, in the areas that feel more tense.

Deep breathing: Whether sitting or lying down, inhale air through your nose from the lower abdomen, hold the breath for a few seconds, and exhale through your nose, feeling your abdomen deflate. Repeat this breathing technique as many times as needed until you feel relaxed and calm.

- Meditation or mindfulness: Focus on scanning your body without making any muscle movements. This involves directing your attention to specific points in your body that you choose, or you can scan through your entire body. The goal is to maintain a mindful awareness of what you are visualising, concentrating on that specific place without any other thoughts interfering.

Image 27



Source: prepared by the authors.

Técnica 2	Technique 2
La respiración profunda	Deep Breathing
Repite esta rutina a menudo hasta que se vuelva automática. Inspira, aguanta 4 segundos, espira, y espera 4 segundos antes de volver a inspirar.	Repeat this routine often until it becomes automatic. Inhale, hold for 4 seconds, exhale, and wait 4 seconds before inhaling again.
El aire entre por la nariz	The air enters through the nose.
El aire llena el estómago	The air fills the stomach.
El aire sale por la boca	The air exits through the mouth.
El abdomen de desinfla	The abdomen deflates.
Cuenta mentalmente los tiempos	Mentally count the timing.
Inspira 4 segundos	Inhale for 4 seconds
Aguanta 4 segundos	Hold for 4 seconds
Espira 4 segundos	Exhale for 4 seconds
Meditación para mindfulness o atención plena	Mindfulness or Mindful Meditation
Mediante la meditación puedes conseguir, practicando a diario, centrar toda tu atención en una sola cosa. De ese modo ahorras preocupaciones, y descansas mejor, porque los problemas que no pertenecen al aquí y al ahora se mantienen fuera de tu mente	Through meditation, if practising daily, you can focus all your attention on a single thing. In this way, you avoid concerns and rest better because problems that do not belong to the here and now stay out of your mind.

Sentado y con la espalda recta	Sit with a straight back
Para meditar busca un espacio libre, en el que puedas estar a solas. Siéntate en el sueño, con ropa cómoda y en la postura que más te agrade, con las piernas estiradas o encogidas	When meditating, find a quiet space where you can be alone. Sit on a cushion, wearing comfortable clothing, and in a posture that suits you best, with your legs either stretched out or crossed.
Ojos cerrados y atento a la respiración	Close your eyes and pay attention to your breath
Concéntrate en tu respiración, siguiendo un ritmo regular. Inspira, mantén al aire en tus pulmones contando hasta 4, expúlsalo y espera contando hasta 4 hasta volver a inspirar	Focus on your breath, maintaining a regular rhythm. Inhale, hold the air in your lungs for a count of 4, exhale, and wait for a count of 4 before inhaling again.
Tu frase de meditación	Your meditation phrase
Cuando tu respiración sea regular, repítete una frase que te motive 'estoy bien', 'me estoy relajando'...	Once your breath is steady, repeat a motivating phrase to yourself, such as 'I am well' or 'I am relaxing.'
Visualiza	Visualise
Intenta recrear una imagen en tu cabeza que signifique algo para ti. Cualquier situación que te resulte agradable (como un paisaje)	Try to create a mental image that holds meaning for you. Any pleasant situation that you find enjoyable (such as a landscape).
Afloja las cuerdas	Release the tension
Repasa los músculos de tu cuerpo, las piernas, los brazos, la espalda, y ordénales que se destensen. Centra tu atención en uno de ellos, por ejemplo, el	Go through the muscles of your body, your legs, arms, back, and instruct them to relax. Focus your attention on one of them. For example, your right calf, and

gemelo derecho, y dale esa orden hasta que sientas que se afloja.	give it that command until you feel it loosen.
Ten paciencia	Be patient
La meditación puede empezar por cinco minutos al día e ir aumentándola hasta intervalos de 30 minutos o más. Lo importante no es que estés mucho tiempo, sino que lo hagas de forma regular.	Meditation can start with five minutes a day and gradually increase to intervals of 30 minutes or more. The important thing is not the duration but the frequency.

- Cognitive techniques: These techniques consist of educational elements that reduce the player's anxiety related to sleep or bedtime. Their objectives include restructuring negative thoughts about lack of sleep and distinguishing problems not caused by insomnia to avoid a catastrophic effect. To work with these techniques, it is recommended to seek the guidance of a professional in psychology or sleep expert.

Conclusions

The importance of sleep for professional female athletes may vary depending on the cognitive and physical demands of their day-to-day profession. We know that football, like other sports, requires the integration of different physical and coordinative capacities, as well as technical and tactical skills, which can enhance performance with increased quantity and quality of sleep.

Athletes should be encouraged to sleep more hours than the general population due to recovery demands imposed by exercise. Different strategies, such as extending sleep duration, taking naps, and sleep and nutrition hygiene strategies, should be considered for the important role sleep plays in the athlete's health and performance. All these considerations should be taken into account based on the individual characteristics of each player. We should be aware that the situations and the different developmental stages of women can change throughout a player's life.

We understand the economic limitations that clubs and institutions have in creating individual plans, so we recommend training on the subject aimed at players, staff, and families, with the goal of providing education and training on sleep and incorporating

some of the recommendations and techniques seen in this module into their daily routines.

Ultimately, maintaining good sleep habits is one of the pillars of taking care of our health, mood, and daily performance. By paying attention to our rest, making changes to our routines, and optimising proper sleep hygiene, we can perform well in all areas of our lives: sports, school, work, and leisure. And we can achieve physical and mental well-being.

References

Ackland, T., Lohman, T., Sundgot-Borgen, J., Maughan, R., Meyer, N., Arthur, D., Stewart, A. y Müller, W. (2012). Current status of body composition assessment in sport: review and position statement on behalf of the ad hoc research working group on body composition, health and performance, un the auspices of the I.O.C. Medical Commission. *Sports Medicine, 42*(3), 227-249. https://pubmed.ncbi.nlm.nih.gov/22303996/

Baker, L. B. (2016). Sweat testing methodology in the field: challenges and best practices. *Sports Science Exchange. https://www.gssiweb.org/sports-science-exchange/article/sse-161-sweat-testing-methodology-in-the-field-challenges-and-best-practices*

Collins, J., Maughan, R., Gleeson, M., Bilsborough, J., Jeukendrup, A., Morton, J., Phillips, S., Armstrong, L., Burke, L., Close, G., Duffield, R., Larson-Meyer, E., Louis, J., Medina, D., Meyer, F., Rollo, I., Sundgot-Borgen, J., Wall, B., Boullosa, B. ... McCall, A. (2020). UEFA expert group statement on nutrition in elite football. Current evidence to inform practical recommendations and guide future research. *British Journal of Sport Medicine, 55*(8). https://europepmc.org/article/med/33097528

Handelsman, D. J., Hirschberg, A. y Bermon, S. (2018). Circulating Testosterone as the hormonal Basis of Sex differences in athletic performance. *Endocrine Reviews*, *39*(5), 803-829. https://pubmed.ncbi.nlm.nih.gov/30010735/#:~:

[Untitled image about phases of sleep]. (n.d.). https://www.elcomercio.com/actualidad/sueno-ninos-estudios-vacaciones-descanso.html

[Untitled image about hours of sleep based on age]. (n.d.). https://adsalutem.es/dormir-bien-es-fundamental/

[Untitled image about female football player]. (n.d.). https://www.facebook.com/fisiocentropalacios/photos/pcb.7784639189384577784637955605136/

Kasper, A., Langan-Evans, C., Hudson, J., James, F., Brownlee, T., Harper, L., Naughton, R., Morton, J. y Close, G. (2021). Come back skinfolds, all is forgiven: A narrative review of

the efficacy or common body composition methods in applied sports practice. *Nutrients, 13*(4). https://www.mdpi.com/2072-6643/13/4/1075

Ledezma, A., Manrique, M., Mantilla, G., Martínez, M. y Tellería, M. (2015). Sueño y descanso en futbolistas femeninas. *Plataforma de Realidades Literarias en el deporte, 3*(2). http://servicio.bc.uc.edu.ve/fcs/atrio/n3/art03.pdf

Logue, M., Madigan, S., Melin, A., Delahunt, E., Heinen, M., Mc Donnell, S. y Corish, A. (2020). Low Energy Availability in athletes 2020: An updated narrative review of prevalence, risk, within-day energy balance, knowledge, and impact on sports performance. *Nutrients, 12*(3). https://pubmed.ncbi.nlm.nih.gov/32245088/

Mata, F., Domínguez, R., Carrera Bastos, P. y Sánchez Olivier, J. (2018). Importancia del sueño en la salud y el rendimiento del deportista. *Revista de Educación, Motricidad e Investigación, 11*. https://www.researchgate.net/publication/329881604_Importancia_del_sueno_en_el_rendimiento_y_la_salud_del_deportista

Microbiota y bienestar. (2022). Fases del sueño. Qué sucede en cada una. https://www.microbiotaybienestar.es/fases-del-sueno-sucede-cada-una/

Moore, D., Sygo, J. y Morton, J. (2022). Fuelling the female athlete: Carbohydrate and protein recommendations. *European Journal of Sport Science, 22*(5), 684-696. https://pubmed.ncbi.nlm.nih.gov/34015236/

Rollo, I., Randell, R., Baker, L., Yanguas Leyes, J., Medina Leal, D., Lizarraga, A., Mesalles, J., Jeukendrup, A., James, L. y Carter, J. (2021). Fluid Balance, Sweat Na+ Losses, and Carbohydrate Intake of Elite Male Soccer Players in Response to Low and High Training Intensities in Cool and Hot Environments. *Nutrients, 13*(2). https://pubmed.ncbi.nlm.nih.gov/33513989/

Sonksen, P. H., Holt, R., Böhning, W., Guha, N., Cowan, D., Barlett, C. y Böhning, D. (2018). Why do endocrine profiles in elite athletes differ between sports? *Clin Diabetes Endocrinol, 4*(3). https://clindiabetesendo.biomedcentral.com/articles/10.1186/s40842-017-0050-3#:~

Thomas, D. T, Burke, D. L. (2016). Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. http://dx.doi.org/10.1016/j.jand.2015.12.006