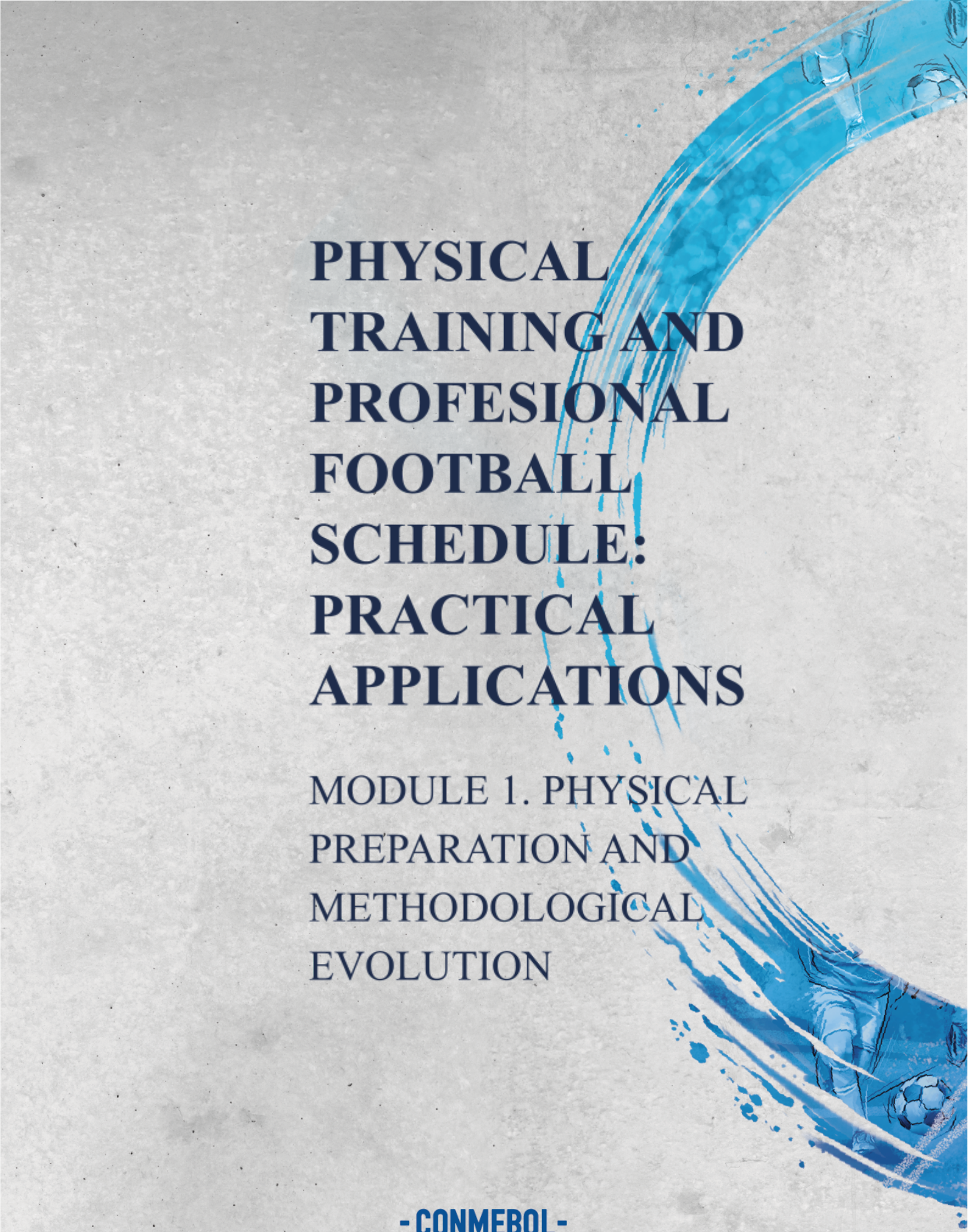
PHYSICAL TRAINING AND PROFESIONAL FOOTBALL SCHEDULE: PRACTICAL APPLICATIONS

MODULE 1. PHYSICAL PREPARATION AND METHODOLOGICAL EVOLUTION



-CONMEBOL-
EVOLUCIÓN

Introduction

Dear Sir or Madam:

In this first module, we will begin the course by addressing the history of physical preparation in football and its influence today, with the emergence of the physical trainer within the coaching staff, the methodological aspects and their evolution in the face of technological developments and the dissemination of scientific knowledge in the world. In addition, we will detail the physiological demands of football practice and the specific physical skills required on the field.

You will discover that the contents of the modules are interconnected, creating a structured and logical line of reasoning, which will facilitate everyone's understanding.

I hope that everyone can share this content in a helpful way and that it serves as another pillar for learning and reflection.

Unit 1.1 Physical preparation and philosophy

Historical evolution and methodological aspects

To understand the importance of physical preparation in the current professional football calendar, it is necessary to go back in time a few decades and analyze the **historical evolution** of this key area for high competition football.

Figure 1: Physical preparation

Source: own elaboration.

Historically, individual sports such as athletics have influenced a large part of the collective sports modalities in terms of **physical preparation**, precisely because of the supposed direct relationship between precise physical preparation and sporting success.

Athletics, one of the oldest sports in the world, is known for presenting the best prepared athletes in speed, power and endurance, and has since aroused the curiosity of the sports world regarding the training of these icons of physical preparation.

Surely, you have already observed physical training of football athletes with the use of exercises and methods derived from athletics. Do you remember *skipping* and running with jumps? Well, these are educational movements transplanted from the track to pre-competitive warm-ups on the football field.

Later, specifically in the post-World War II period, the search for the best methods of physical preparation for athletes was based precisely on **militarism**. At that time, where were the people best prepared to withstand the overwhelming demands of military training?

Thus, like athletics, military training and its methods exerted a great influence on the preparation of football athletes during the 1940s and 1950s.

And it is precisely from the 1950s onwards that physical preparation in football underwent its **first major transformation**. Let's use as an example the participation of the Brazilian national team in the World Cup.

In the edition held in **Sweden in 1958**, the Brazilian technical commission was composed of few members, centralizing the responsibility for all training in the hands of the coach, still under the strong influence of military preparation methods.

In 1966, in the World Cup in England, given the disqualification already in the first phase, it was noticed that the physical evolution of the European athletes had surpassed that of the Brazilians. This meant that, for the **1970 World Cup in Mexico**, special emphasis was placed on the physical preparation of the national team. This was a period in which scientific knowledge spread throughout the world and the role of a specialist, such as the physical trainer within a football coaching staff, became essential.

Therefore, with the advancement of technology and the speed of transmission of information in the scientific and sports fields, physical preparation in football is undergoing its **second great transformation**, creating a modern scenario of preparation for high performance.

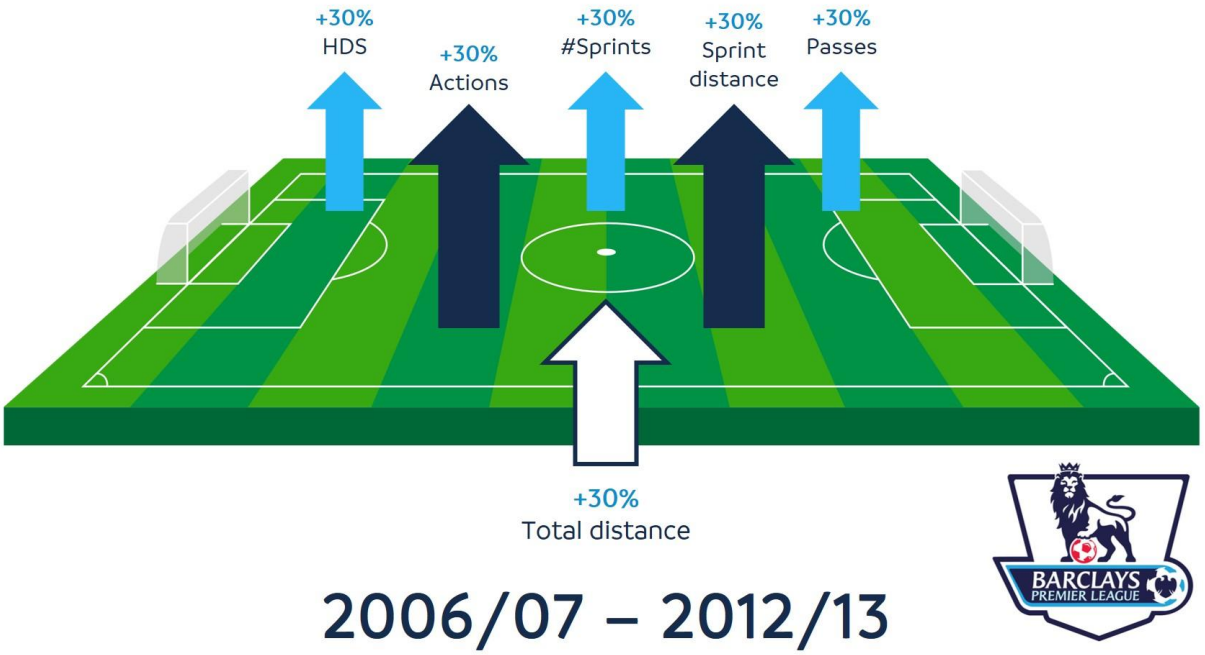
However, before delving into these issues, it is essential that we detail the demands of the game and the specific physical skills on the field, which guide the choice of the best paths for the development of the player.

Game requirements

Football features a variety of **intermittent high-intensity**, **linear, multidirectional actions** interspersed with **long periods of low-intensity activities** (Mohr; Krustrup; Bangsbo, 2003). Depending on the position, a professional football athlete may run between 10-12km per match and reach sprint speeds (> 25km / h) several times throughout the match, which requires optimal physical and physiological condition to withstand these efforts.

To give everyone a clear idea of how much football has evolved in technical, tactical and above all physical matters in recent decades, let's analyze a study published in 2014 on **physical changes in Premier League** (English football Championship) **matches.**

Figure 2: Changes in physical variables in the Premier League.



Source: own elaboration.

It should be noted that we do not want to compare European and South American football in isolation, as we are fully aware of the differences that exist in the game model, culture and football philosophy.

Comparing the **2006/07 and 2012/13** English Championship **Seasons**, teams presented, on average:

30% more **distances covered at high intensity**, i.e., over 20 km/h;

80% more number of ***sprint* efforts** (over 25 km/h);

35% more ***sprint* distances covered**, in meters;

50% more **high intensity actions**;

12% more **passes**;

2% more **total distances traveled**.

As we can see, football evolved enormously and physical preparation needed to accompany this transformation. We will talk more about this evolution later in the course. Now, let's move on to one more example.

View the **physical demand** of the highest representation of professional football, the **2018 World Cup**. In the following figure, the values refer to the average of all group stage matches, separated by position, of those players who actually participated in the matches (90 minutes).

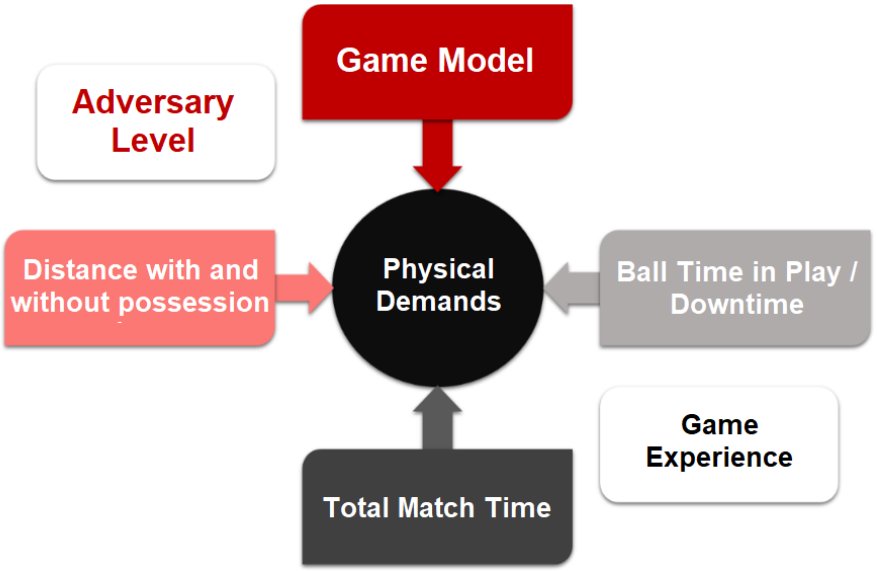
Figure 3: Physical demands at the 2018 World Cup.

Source: own elaboration.

Note that, separated by position, there are considerable differences in physical demands, as the players have **different roles on the field** (defenders - *central* defenders and midfielders - *central attacking midfielders*). Even so, it is worth noting the number of *sprints* performed (runs > 25km/h), reaching almost 41 very high intensity efforts in 90 minutes, for the wingers (*attacking midfielder)*. Visibly, the demands of professional football reached previously unimaginable values.

Of course, in any discussion of the **characteristics and demands of the game** in professional football, we must consider those intervening factors that guide the analysis of physical demands.

Figure 4: Physical demands in non-professional football.



Source: Paul et al.,2015, https://bit.ly/3mcu8df

The **game model** is a primordial factor and the first to be highlighted. Depending on the ideas of the game, based on the club's philosophy and the coach's intentions, the demands on the field will be specific and directly linked to the phases of the game. We will deal with this topic in depth in Module 3.

Ball time in play / Downtime defines much of what will be the physical demand of a given match. This depends on events throughout the game, such as the number of infringements, interruptions by the referee, ball out of play, etc.

The **total match time**, depending on the current rule of VAR use in which the discount minutes increased significantly, also influences how much the athlete is demanded throughout the match. We have followed matches up to 104 minutes long, generating a

high demand on the total distance covered and high intensity runs, in addition to the physical/emotional wear and tear.

The distance covered with and without ball possession is a very interesting factor and is part of a modern and systemic analysis of the football game. Allied to the physical demand, the performance of the athlete/team contextualized to the game offers important information to analyze the demand throughout the match.

A very interesting **study** conducted **in the Bundesliga** (German football championship) showed that a higher **total distance run combined with a higher ball possession** seems to have a **positive effect on the final position** in the championship table (Hoppe *et al.* , 2015) than only a long distance run.

And, last but not least, **the level of the opponent** and **the game experience** also interfere with the physical demands of the game. To make it clearer, two similar **studies** showed that, in the **English and Italian championships**, the teams at the top of the table covered a shorter total distance and shorter distance at high intensity (> 20 km/h) than the teams in the bottom places.

Do you notice how much we, football fitness trainers, need to address physical demands as a starting point for training prescription, development and monitoring of the athlete/team?

In order for these demands to be supported by the professional football athlete, **sport-specific physical capabilities** must be identified and included in the training program. That will be the focus of our next topic.

Unit 1.2 Specific physical capabilities

Football is a sport that requires several skills from the athlete, including refined **technical competence**, a good **tactical understanding of the game**, a performance-focused **mental attitude** and, in addition, excellent **physical fitness**.

The predominant energetic pathway is the **aerobic** one, characterized by the variation between running, jogging and walking at low intensity most of the time. The **anaerobic** pathway is present in sprints and high intensity actions, such as jumps, shots and accelerations, being the ones that determine the important moments of the game.

That said, considering the characteristics of the game: high intensity, intermittency and random sequence of phases of effort and rest, the football player must present, mainly but not only, optimal levels of determinant capacities such as **speed, strength and endurance.**

Speed

Speed is understood as the ability to perform **motor actions in the shortest possible time** and **as efficiently as possible.**

In football, speed is a multiple capacity that depends on **quick reaction**, situation management, quickness to initiate and follow the movement, ball skills, **dribbling and quick recognition** and use of the respective situations (Universidad del Fútbol, 2008).

The main subdivisions of speed are:

Reaction speed: the ability to react to a signal in the shortest possible time;

Acceleration speed: this is related to muscle strength; for a good acceleration speed, the muscle must be pushed to its limit;

Speed endurance: it is understood as the ability to maintain speed for as long as possible.

There are also secondary manifestations, such as: speed of **perception**, **anticipation**, **decision**, movement with or without the ball. Only with the manifestation of all these characteristics, speed can be fully developed as a complex capacity (Universidad del Fútbol, 2008).

Speed is a **less "trainable"** physical value than strength or endurance. This means that the individual will improve this capacity very little with training, due to the influence of the **genetic factor** and the constitution of **muscle fibers**, for example.

The speed of the football player represents a very complex quality formed by spatial, technical, cognitive and psychological abilities. The most important of these complex abilities are: **reaction speed** - resulting from the speed of perception, anticipation and decision, and **speed ability** - ability resulting from the speed of

reaction, movement and action (Universidade do Futebol, 2008, https://bit.ly/3yXgkab).

Force

Strength capacity is one of the pillars of football, as it is present in several moments of the game in combination with other physical capacities. However, it is not exactly the strength with characteristics of conventional training for aesthetic purposes or powerlifting (bodybuilding, bodybuilding, etc...).

"If we only train the muscles, we will forget the movements ... but if we train the movements, we will never forget the muscles." - Nick Winkelman

Strength is perhaps the most important skill in football training, mainly if it is related to specific training. Other abilities, such as speed, for example, do not exist without strength, as it becomes a prerequisite for other developments (Eiras, 2017).

In a practical and concrete way, strength is that based on **field movements**. The characterization of strength parameters consists of the muscular action performed in the movements of jumping, colliding with the opponent, changing direction and running at high speeds (Styles; Matthews; Comfort, 2016; Hoff, 2004).

"Force means applying your energy at the right time. Otherwise, strength is useless. If you are very strong and every time you try to get the ball back, you foul, you are lost." - Paco Seirul-lo

Resistance

Traditionally, endurance can be described as the ability to exercise effectively, overcoming fatigue (Platonov, 2008). Several factors can influence the level of endurance development, such as: bioenergetic potential of the organism, specificity of the sport, technical and tactical efficiency and even psychological aspects.

This variety of intervening factors led to different classifications for endurance parameters in the sports environment. One of the most commonly used classifications is the division into specific and general endurance.

Specific endurance consists of the ability to perform work and tolerate fatigue under specific sporting conditions. On the other hand, general endurance is defined by its non-specific character in the performance of physical work.

With the evolution of the physical and physiological demands of the game in the last decades, a new look at endurance capacity started to apply in football. **Metabolic endurance** is a term currently used, considering the concepts of load control (see Module 2) that considers the following elements:

Intermittency refers to moments of temporary interruption, intervals between events. In the case of the game of football, it is represented by the intermittent characteristic of high intensity actions, interspersed with recoveries of varying durations.

The concept of **duration** can be understood as the elapsed time of each exercise, set, recovery interval or even training session.

Recovery (pause) refers to the intervals between actions performed in the field, which can be classified into:

Incomplete recovery means that the athlete does not have enough time to recover from an action, considering a pause interval shorter than that action. Consequently, at each start of a new action, the athlete starts from a state of fatigue greater than the initial state.

Full recovery means that the athlete's action has a duration equal to or shorter than the pause interval, allowing a greater recovery that can reach close to the initial levels of the athlete's state.

And finally, **fatigue tolerance** consists of withstanding the high-demanding effects of intense game actions, as well as quickly restoring the body for the next activity.

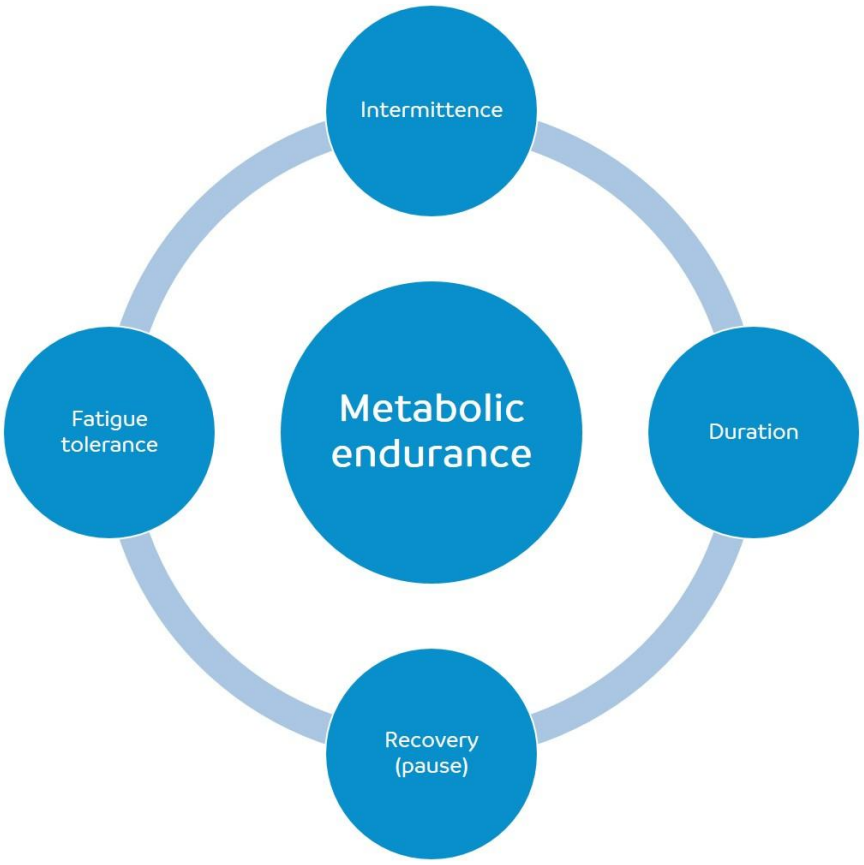
Thus, the objective of metabolic endurance is not only to **prolong high intensity effort**, but above all, to allow adaptations that increase the capacity to **recover quickly and efficiently between efforts.**

For example: a fullback drives the ball into attack in his lane and, after a 40m *sprint*, has to deliver a cross into the box. However, if the cross is poorly executed, he will have to

quickly recover his position and, as soon as possible, return to attack. This action is prolonged in time and is repeated randomly, varying the duration of effort and recovery.

Metabolic endurance is therefore the **ability to maintain the pattern of play** throughout a match, without a sudden drop in intensity or speed. Depending on the role played by the athlete, specific needs must be respected and promoted within the training.

Figure 5: Aspects related to metabolic endurance



Source: own elaboration.

As can be observed, there are specific physical capacities for the practice of high-level football and they must be trained throughout the season. For this purpose, we have organized the following content to present how the training of these capabilities can be performed.

Unit 1.3 Training of physical abilities in professional football

Training means and methods

With the globalization of sport and the speed of transmission of information in recent decades, the means and methods of training in various countries have spread vertiginously, to the point of using training ideas from Europe and Asia here in South American countries.

The term "means" in the language of sport means **that it is used** and "method" is the **way in which** the means **is used** to achieve the given preparation. Therefore, the "means" is the physical exercise and the method is the way in which the means is used (Gomes, 2002).

Nowadays, there are numerous training methods and methods oriented to football that contemplate the determinant capacities of strength, speed and endurance. Among them, we can highlight:

Figure 6: Means and methods of training for football

Source: own elaboration.

New approaches to strength and speed (power)

If, on the one hand, muscular strength and its more direct expressions do not depend on the speed of muscular contraction, on the other hand, **power** expresses the multiplication between strength and speed.

Thus, muscle power can be increased by improving strength or speed, but in general its maximum values are reached at a level between the minimum and maximum possible force generation at a high speed (different from the maximum speed without external load, for example).

At this point, we will focus on the most commonly used means and methods in football, as well as new approaches in recent years.

Plyometry

Plyometric exercises are characterized by **stretch-shortening cycle** (eccentric pre-stretch phase, damping phase and concentric shortening phase) (Davies et al., 2015). This cycle strengthens the elastic properties of the connective tissue, thus improving strength and power and allowing **the muscle to build up and release energy** (Khlifa et al., 2010).

During jumping and running, for example, the lower limbs have spring-like characteristics, which compress contact with the ground, storing energy, before recovering and releasing this energy through a rebound effect (Hobara et al., 2008), with the tendon being the primary location for elastic energy storage (Lichtwark; Wilson, 2007; Kubo et al., 1999).

The specific physiological adaptations induced by plyometric training are: increased motor unit activation, increased passive tension of the muscle-tendon complex and improved cross-bridge mechanics (Ramirez-Campillo et al., 2015a). These adaptations are associated with increased strength, increased joint stiffness and improved neuromuscular control and functional performance (Ramirez-Campillo et al., 2015b).

A jump has three moments: **propulsion, flight and landing.**

The athlete can jump with both feet on the ground and land with both (*jump*); jump with only one of the limbs on the ground and land with that same limb (*hop*) and jump with only one of the limbs and always land with the opposite side (*bound*).

When they are well taught and the athlete has learned to control mainly the last phase of the jump (landing), precisely the one that requires greater motor control, plyometric exercises become a great ally in training. In the landing phase, the athlete performs triple flexion of ankle(s), knee(s) and hip, predominantly eccentric strength (Rodrigues; Nakamura; Rabelo, 2019).

A very relevant aspect when we talk about plyometric exercises is the **ground contact time (TCS)**, which allows them to be classified as slow (TCS ≥ 0.251 s) or fast (TCS ≤ 0.250 s) (Turner; Jeffreys, 2010). Some examples of TCS during varied movements, with their respective classifications: *Sprint (pique) (*0.08 to 0.09 s, fast), *drop jump* 20 cm (0.130 s, fast) and 60 cm (0.300 s, slow) and multiple hurdle jumps (0.150 s, fast) (Laffaye; Wagner, 2013; Ball et al., 2010; Walsh et al., 2004).

Verkhoshansky (2016) determines that, for initiation to plyometrics, the height of the box for the *drop jump* should be between 30 and 50 cm. For explosive strength and reaction speed, approximately 75 cm, and for maximal strength, between 1 and 1.10 m.

To perform plyometric training, the presence of a box is not mandatory. However, to apply overload, we can use higher heights or then the athlete can use a vest with weights (Rodrigues; Nakamura; Rabelo, 2019).

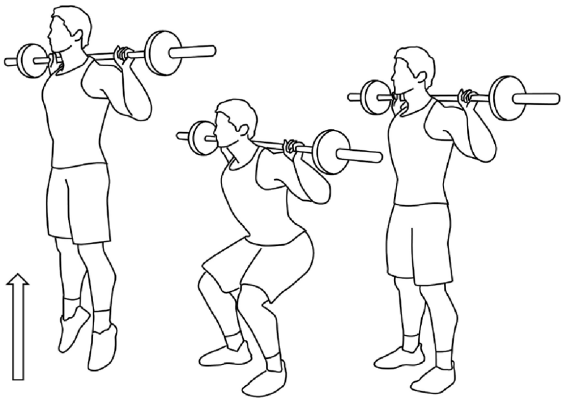
For the success of this type of activity, the **speed of execution**, **the amplitude of movement** and the **minimum time of contact with the ground** are fundamental, being unipedal exercises obviously more intense than bipedal exercises (Jeffreys, 2007).

Jump squat (jump squat)

The **overhead vertical jump** (*jump squat*) is one of the exercises that has emerged in recent years as an excellent alternative to develop explosive strength. Studies show that *jump squat* can improve linear *pike* capacity and change of direction tasks (Loturco et al., 2016; Loturco et al., 2015b; Loturco et al., 2015c).

The idea is to use a barbell on the back and perform vertical jumps with countermovement, taking advantage of the elastic energy accumulated by the stretch-shortening cycle mechanism. The optimal load indicated for this type of training is around 60% of body weight, and the optimal average propulsive power is reached at around 1 m / so with a jump height of approximately 20 cm (Loturco et al., 2015c).

Figure 7: Jump squat performance



Source: Rodrigues et al.,2019, p. 232.

If you do not have a jump plate available, you can easily use a commercially available app that measures jump height from the camera on your *tablet* or *smartphone.*

The number of programmed repetitions depends directly on the quality of the execution of the movement, based on the references of bar displacement speed (1 m/s) or height

reached in the jump (20 cm). As with traditional power training concepts, once there is a considerable drop in the force generated, we are no longer training this capacity efficiently (Rodrigues; Nakamura; Rabelo, 2019).

It should be noted that this exercise should be implemented only after the athlete has completed all the stages of learning to jump and land. Since it has a load on the back, the techniques of jumping, keeping the bar firmly in contact with the trapezius and landing in a controlled manner must be well perfected.

Traction racing

Traction running with **sled, *sled bag or* traction belt**), an exercise that provides overload **in the horizontal direction** by requiring the athlete to push the ground backwards in a triple extension action (hip, knee and ankle), is effective in improving acceleration.

It is important to highlight that, in the case of using the sled, the **choice of the load** to be pulled should be relativized in relation to the athlete's body weight. Studies suggest using 7 to 13% of the athlete's weight (Morin et al., 2016), but there are authors who recommend the use of up to 80% of the body weight (Alcaraz; Palao; Elvira, 2009).

Therefore, two objectives can be highlighted when choosing the sled load:

Short acceleration: heavier loads;

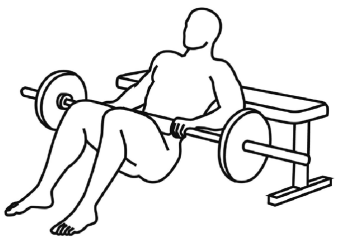
Maximum speed: lighter loads.

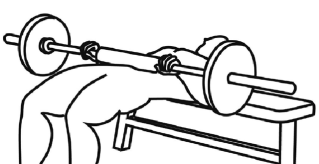
We must pay special attention to the **execution of the running movement with traction**, because, if the overload is exaggerated, the running pattern will be altered and the movement will be unbalanced and compensatory. In relation to traction belts, prefer those that use longer elastic ropes, which allow greater freedom of movement during accelerations.

As mentioned above, the involvement of **triple extension** in the execution of a good acceleration, activating the muscles in charge of pushing the ground (gluteus maximus, rectus femoris, gastrocnemius, etc.) is fundamental to generate power to **move forward** (Rodrigues; Nakamura; Rabelo, 2019).

Hip thrust exercise is an excellent means of developing this capacity, showing a high association with the acceleration phase from 0 to 10 meters (Loturco et al., 2018).

Figure 8: Hip thrust performance





Fonte: Rodrigues, et al., 2019, p. 232.

Repeated sprints

The ability to perform repeated *sprints* has been considered one of the most important aspects for the football athlete. In several moments of the game (offensive and defensive transitions), one can observe the intense demand to perform ***sprints* in sequence** after a recovery, a definition, a ball loss, a goalkeeper's save, etc. (Rodrigues; Nakamura; Rabelo, 2019).

Therefore, in order for the athlete to withstand repeating these intense actions at high performance, he or she must deal with the physiological demands generated by these intense moments. These physiological demands (neuromuscular and metabolic) imposed by repeated intense actions in football require a special focus on capacity development.

Therefore, some **physiological mechanisms** involved must be improved:

Neuromuscular:

- Neural triggers;

- Activation of motor units;

- Muscular strength.

Metabolic:

- Oxidative capacity;

- Restoration of creatine phosphate;

- Regulation of lactate-H+.

Considering that the repeated *sprinting* ability involves the participation of **speed, strength/power and aerobic endurance**, some specific training methods can help to perfect this ability: plyometric training, maximal sprint *training*, strength training, aerobic training, intermittent training (reduced sets) and repeated *sprint* training itself.

Repeated *sprint* training has a wide range of variations from distance covered, direction of travel (linear/multidirectional), number of sets and repetitions, with open or closed task, duration of pauses and types of recovery (passive/active) (Rodrigues; Nakamura; Rabelo, 2019).

Multidirectional

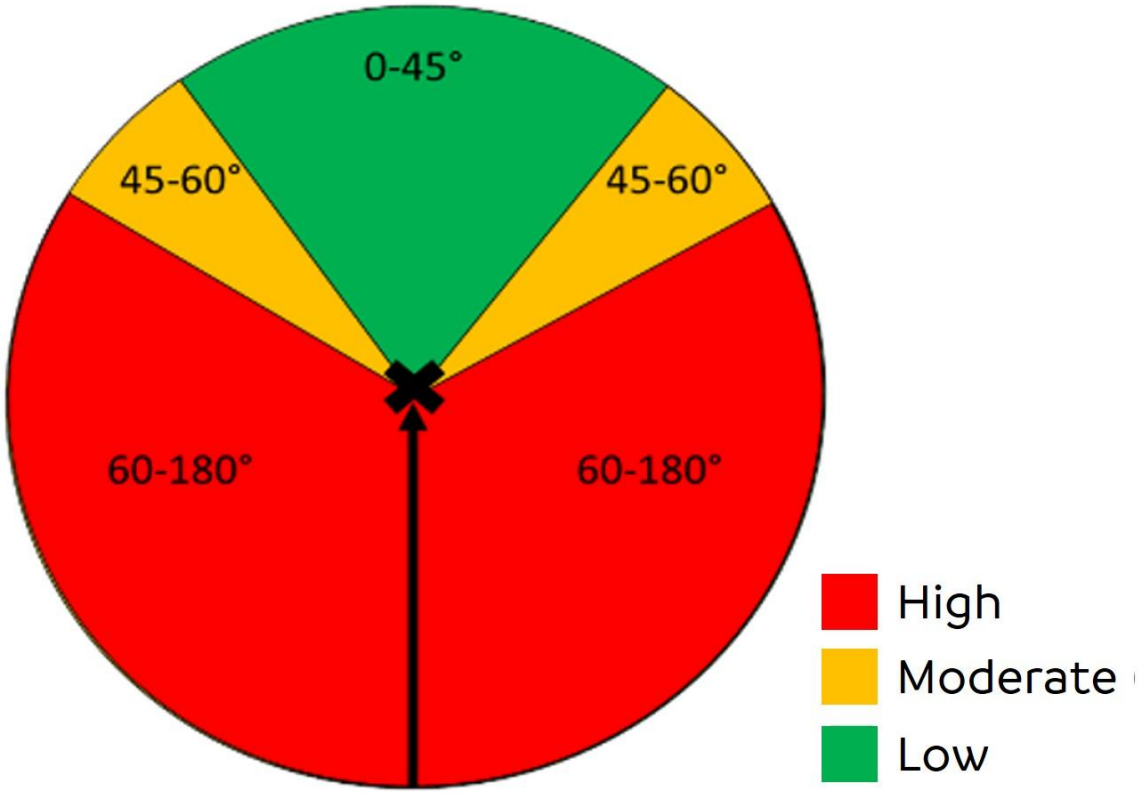
Football, with its characteristic acyclic, intermittent and many decelerations in short spaces, requires an extremely refined multidirectional movement capacity.

Imagine that, during a match, the athlete performs between **500 and 700 changes of direction** depending on the position (Bloomfield; Polman; O'Donoghue, 2007) and presents, **on average, a change of action every 5-6 seconds** (Reilly; Williams, 2003; Strudwick; Reilly; Doran, 2002).

Many of these behavioral changes begin with changing phases of the game that require the athlete to have the power and neuromuscular control to change direction efficiently and run backwards in a defensive transition situation, for example.

To train multidirectional acceleration, we must think about how they occur in football so that we can stimulate in training what will be demanded in the game. However, a mistake made by many physical trainers is to focus only on changes of direction at 90° (left or right "L" angles) and 180° (back and forth). Multidirectional acceleration goes far beyond just generating power in leg movement and running the other way (Rodrigues; Nakamura; Rabelo, 2019).

Figure 9: Degree of demand based on change of direction angles



Source: Dos'Santos et al., 2018, https://bit.ly/3z3sbn1

According to the angle of change of direction, the strategic actions of **pre-support contact**, from the entry of the **supporting foot** (front / side) and **post-support exit** should occur for the best multidirectional execution (Rodrigues; Nakamura; Rabelo, 2019).

It is important to note that the change of direction is "**speed dependent**", i.e., depending on the speed of approach to the point of change of side, the athlete must make adjustments in deceleration with pre-support contact, **impact absorption** and **reorientation of the force** towards the direction in which he/she wishes to move.

Therefore, following the **multi-step** concept of multidirectional movement, pre-support contacts are extremely important for an efficient and economical change of direction and should also be trained, in addition to the focus on the supporting foot.

The alternating unilateral *bound* exercise, performed in different directions and planes, is excellent for developing both the ability to generate power in the **change of direction** during the entry phase of the supporting foot, as well as the ability to **absorb impact** and **deceleration** of the legs and trunk necessary in the contact phase prior to support.

Thinking about the emphasis of the exit after the support, an interesting exercise such as the lateral pass with elastic rope, traction belt (or without load), generates an excellent stimulus to teach the athlete to **push the** floor **horizontally to** the side.

Linear and multidirectional movements have different ways of development, both within a more controlled environment, i.e., the athlete already knows what he/she is going to perform previously, as well as in a **chaotic scenario**, where the athlete must make the decision and react to a stimulus, whether visual, verbal or sensory, generating **unpredictability in the action.**

This is exactly why we currently differentiate the term agility from change of direction. While one is related to the **open environment generating a reactive component**, the other refers to a **closed environment with predefined actions**. For example, a multidirectional exercise in which the athlete already knows in advance in which directions he/she is going to move.

Depending on the interaction of the athlete with his environment, there may or may not be proximity, or not, with the **concept of specificity** within football, knowing that a human being only executes an action from a previous perception and reading.

Therefore, it is extremely important for the athlete to be able to experience different types of situations, improving not only his or her ability to execute, but also his or her speed of decision/reaction.

Strength training

Historically, strength training has been used as a method to develop athletes throughout their careers, regardless of sport modality. However, it is not exactly strength for aesthetic or basic weightlifting purposes (bodybuilding, powerlifting, etc.).

Strength training in football consists of addressing **three fundamental points**:

1. **Building** a solid base of general strength through **multi-joint** exercises, focusing on body awareness and its **relationship with the external environment;**
2. **Implementation of** targeted strength from total body movements, creating a **connection** between upper limbs, trunk, hip and lower limbs, focusing on force generation in explosive combined actions;
3. **Consolidation of** specific strength by stimulating explosive and reactive actions, at the maximum possible **contraction speed**, from complex integrated movements that generate energy efficiently.

It is important to have very well defined objectives at the end of each period that will guide the process of **progression** and **continuity** of training. In this sense, we establish as a goal which exercises are fundamental for the athlete and how they will be developed throughout his training and development period.

Thinking of strength training as a continuous process, we consider **3 key variables** in the progression:

TECHNIQUE: this is certainly the most complex variable in strength training and will require the most attention and quality in the physical trainer's prescription, since performing movements in an integrated, balanced and quality manner requires an **individual neuromotor repertoire**. During this period, much emphasis needs to be placed on details such as movement plans, recruited muscle groups, joint mobilities and axial and segmental stability.

When developing the technique, it is necessary to divide the exercises into parts that require **perception, awareness, execution and automation**. Always having as a premise, the progression from simple and isolated exercises to complex and integrated exercises.

The technique must be very well guided by the objective of each cycle, considering that it is necessary to have frequency of execution and the certainty of the consolidated goal, in order to be able to advance to a new cycle. Much attention is directed to the training categories, in which **the maturation period** can directly influence the functional pattern of the movements.

Therefore, it is only when the athlete is able to **master the technique** of a given exercise that we evolve in relation to speed and overload.

SPEED: variable that exerts the greatest influence on the concept of Functional Strength. Two factors are determinant for the evolution of this variable:

- The **choice of exercises**: prioritize exercises that favor the mechanics of **propulsive** and **explosive** movements and, consequently, increase the **speed of execution;**
- The **form of control**: use of practical and functional pneumatic devices that present real time measurement of the power performed (watts). In this sense, it is necessary to find an **overload *baseline*** for each exercise, which will serve as an evolution parameter.

OVERLOAD: variable dependent on biological factors such as weight, structure and genotype, so it must be individualized. Among the means of overload control, we use the following:

- **Load**: is determined by the weight and type of equipment that is used during the exercise. Example: rings, kettlebells, balls, dumbbells, superbands, power bags, vests, machines, etc. In this sense, it is important to find the **ideal load for each athlete** and, above all, that there is a **progression** in relation to the load in each exercise according to the response. A principle that will be very important in this process is that of **continuity**, it is necessary for the athlete to train frequently.
- **Type of exercise**: is determined by the specific characteristics of Functional Strength focused on football, i.e. the choice of exercises according to **specific movements present in the game**. Example: Three fundamental movements for the football athlete: Acceleration (start), deceleration (braking) and change of direction. For each of these movements we will have a series of exercises that must be worked according to their objectives:
- **Acceleration (start)**: exercises with a more explosive character (**concentric action**), with **horizontal force vectors**, where there is a predominance of force over speed in the power curve ratio. Exercises such as horizontal jumps, resisted piques (traction, sled or inclined running), throws and pushes (bi or unilateral) are important in this process.
- **Deceleration (braking)**: exercises of a more tensional nature (**eccentric action**), where speed is superimposed on force, with horizontal and vertical vectors. Emphasis should be placed on unilateral exercises focused on neuromotor control of the hip (support). Isoinertial exercises are also excellent in this process.
- **Change of direction**: exercises with a more elastic character (action with **stretch-shortening cycle**). Plyometric exercises, resisted *piques* and jumps with overload (*optimal power load*) are very effective in this process, but it is necessary

to pay close attention to the evolution in terms of technique. Therefore, it is important that the process is continuous and is built throughout the process of training and development of the athlete.

In a more current approach, exercises that simultaneously train different planes and joints, which are specific to the environment, are favored.

When analyzing a **line of functionality** for sport, we realize that the complexity increases due to the chaotic and unpredictable nature of football. This leads us to a connection of human movement patterns (crouching, rolling, jumping ...) that intersect to achieve the goal of the task, **transferring energy in different planes of motion.**

Therefore, in addition to the standards, we must consider how the force is applied on the body, which results in **different vectors** and leads to **different kinetic effects** throughout the athlete's structure.

Reflecting on how we can organize the functionality of strength, the literature shows us diversified paths that can be useful in the construction of what is operational for our sport.

Some good practices help us with concepts of great references in sports training / movement: Michael Boyle, Pavel Kolar, Gary Gray, Thomas Myers.

1. **Motor skills** (jumping, bending, throwing ...);
2. **Joint by joint** (mobility and stability);
3. **Movement patterns** (dynamic neural stabilization);
4. **Application of force on the body**;
5. **Planes of motion** (sagittal, frontal, transverse);
6. **3D *MAPS*** (anterior, posterior, lateral of the same side, lateral of the opposite side,

rotational of the same side, rotational of the opposite side);

7. **Functional lines**.

Intermittent training (reduced sets)

For this ability, we will essentially focus on **small-sided sets**, one of the most used training methods in football, precisely because it is contextualized with the game and its specific actions on the field.

The training variables **duration** and **stimulus: pause relationship** must be very clear, because they give sense to the type of conditioning that is intended to be developed in the

athlete, since the game of football is developed in situations of varied actions and rest intervals.

Firstly, the concept of duration can be understood as the elapsed tempo of each exercise, set, recovery interval or even of the training session. And, secondly, the stimulus: pause ratio (E: P) means to what extent the duration of the stimulus (**action**) is connected to the duration of the pause (**recovery**). For example:

1) A reduced set G + 4v4 + G of 3 sets of 4 minutes and 2 minute pauses in between have a stimulus: pause ratio of 2:1;

2) On the other hand, a reduced set G + 4v4 + G of 3 series of 4 minutes and pauses of 1 minute, between them, have a ratio of 4: 1.

Let's analyze it calmly. In example 1, there is more recovery time between sets which, in principle, allows more time for the athletes to rest in the pause intervals. And this, while characterizing an incomplete recovery between sets, generates a different **workload** from example 2.

But what does this term incomplete recovery mean?

Incomplete recovery means that the athlete does not have enough time to recover from an action, considering a pause interval shorter than that action. Consequently, at each start of a new action, the athlete starts from a state of increased fatigue (represented by the heart rate in the figure above).

Examples: E: P of 2:1; 2:0.5; 2:0.25.

Full recovery already means that the athlete's action has a duration equal to or shorter than the pause interval, allowing for further recovery that can reach close to the athlete's initial state levels.

Examples: E:P of 1:1; 1:2; 1:3.

Well, considering that the **football match** presents a characteristic of **intermittency** with **high intensity actions**, interspersed with **incomplete recovery**, should we always train in incomplete recovery to reproduce the demands of a match?

It is relative. Reflect on the points presented below:

1) In the **preseason**, a period in which athletes come after a long vacation, is it wise to use only incomplete recovery in the first week of training, knowing that the athletes are detrained?

2) On training days **after the match** (day +1, day +2 or even day +3), would it be interesting to allow more complete recoveries between sets, considering the restoration process of the athlete's body?

3) With the aim of applying a more intense training, would it be more appropriate to have few interventions by the coach **during the exercises, so that the athletes** do not "return to calm" at all times?

Thinking through the smallest details of the training application creates the possibility of achieving a high level of intensity and concentration of the athletes throughout the entire session.

In the next module, we will delve into the subject of load control in football and its importance in the planning and prescription of training.

References

Alcaraz, P.E., Palao, J.M., Elvira, J.L.L. Determining the optimal load for resisted Sprint training with sled towing. J Strength Cond Res. 2009; 0 (0): 1-6.

Ball, NB, Stock, CG, and Scurr, JC. Bilateral contact ground reaction forces and contact times during plyometric drop jumping. J Strength Cond Res 24(10): 2762-2769, 2010.

Bloomfield J, Polman R, O'Donoghue P. Physical Demands of Different Positions in FA Premier League Soccer. J Sports Sci Med. 2007;6(1):63-70. Published 2007 Mar 1.

Davies, G., Riemann, B.L., Manske, R. Current concepts of plyometric exercise. Int J Sports Phys Ther. 2015 Nov; 10(6):760-86.

Di Salvo V, Gregson W, Atkinson G, Tordoff P, Drust B. Analysis of high intensity activity in Premier League soccer. Int J Sports Med 2009; 30: 205–212.

Dos'Santos, T., Thomas, C., Comfort, Jones, P.A. The Effect of Angle and Velocity on Change of Direction Biomechanics: An Angle-Velocity Trade-Off. Sports Med. 2018; 48: 2235-2253.

Eiras, F. Fuerza, fútbol y especificidad. Universidad del Fútbol, 2017. Disponible en: https://universidadedofutebol.com.br/2017/05/06/forca-futebol-e-especificidade/. Consultado el: 05/01/2021.

Gomes, AC Entrenamiento Deportivo - estructuración y periodización. Artmed Editora, 2002.

Hobara, H., Kimura, K., Omuro, K., Gomi, K., Muraoka, T., Iso, S., Kanosue, K. Determinants of difference in leg stiffness between endurance- and power-trained athletes. J Biomech 41: 506-514, 2008.

Hoff, J.; Helgerud, J. Endurance and Strength Training for Soccer Players. Sports Medicine; 34(3): 165-80, 2004.

Hoppe MW, Slomka M, Baumgart C, Weber H, Freiwald J. Match Running *Performance* and Success Across a Season in German Bundesliga Soccer Teams. International Journal of Sports Medicine. 2015 Jun;36(7):563-566.

Jeffreys I. Total Soccer Fitness. Monterey, California: Coaches Choice, 2007.

Khlifa, R., Aouadi, R., Hermassi, S., Chelly, M.S., Jlid, M.C., Hbacha, H., Castagna, C. Effects of a plyometric training program with and without added load on jumping ability in basketball players. J Strength Cond Res. 2010 Nov; 24(11):2955-61.

Kubo, K., Kawakami, Y., Fukunaga, T. Influence of elastic properties of tendon structures on jump *performance* in humans. J Appl Physiol 87: 2090-2096, 1999.

Laffaye, G. and Wagner, P. Eccentric rate of force development determines jumping *performance*. Computer Methods in Biomechanics and Biomedical Engineering. 16(1), p. 82-83. 2013.

Lichtwark, G.A. e Wilson, A.M. Is Achilles tendon compliance optimised for maximum muscle efficiency during locomotion? J Biomech 40: 1768-1775, 2007.

Loturco I., Nakamura F.Y., Kobal R., Gil S., Pivetti B., Pereira L.A., Roschel H. Traditional Periodization versus Optimum Training Load Applied to Soccer Players: Effects on Neuromuscular Abilities. International Journal of Sports Medicine, 2016; Dec; 37(13):1051-1059.

Loturco, I., Contreras, B., Kobal, R., Fernandes, V., Moura, N., Siqueira, F., Winckler, C., Suchomel, T., Pereira, L.A. Vertically and horizontally directed muscle power exercises: relationships with top-level sprint *performance*. PLOS ONE. 2018; 13(7): e0201475.

Loturco, I., Nakamura, F.Y., Kobal, R., Gil, S., Cal Abad, C.C., Cuniyochi, R., Pereira, L.A., Roschel, H. Training for power and speed: effects of increasing or decreasing jump squat velocity in elite young soccer players. J Strength Cond Res. 2015b; 29: 2771-2779.

Loturco, I., Nakamura, F.Y., Tricoli, V., Kobal, R., Cal Abad, C.C., Kitamura, K., Ugrinowitsch, C. Gil, S., Pereira, L.A., González-Badillo, J.J. Determining the

optimum power load in jump squat using the mean propulsive velocity. PLOS ONE. 2015c; 10(10): e0140102.

Mohr M, Krustrup P, Bangsbo J. Match *performance* of highstandard soccer players with special reference to development of fatigue. J Sports Sci 2003; 21:519-528.

Morin, J.B., Petrakos, G., Jiménez-Reyes, P., Brown, S.R., Samozino, P., Cross, M.R. Very-heavy sled training for improving horizontal force output in soccer players. Int J Sports Physiol Perf. 2016; 11: 1-13.

Paul, DJ and Bradley, PS and Nassis, GP (2015) Factors affecting match running *performance* of elite soccer players: shedding some light on the complexity. International journal of sports physiology and *performance*, 10 (4). pp. 516-519.

Platonov, V. Tratado General de Entrenamiento Deportivo. 1ª ed. São Paulo: Phorte, 2007.

Ramírez-Campillo, R., Burgos, C.H., Henríquez-Olguín, C., Andrade, D.C., Martínez, C., Álvarez, C., Castro-Sepúlveda, M., Marques, M.C., Izquierdo, M. Effect of unilateral, bilateral, and combined plyometric training on explosive and endurance *performance* of young soccer players. J Strength Cond Res. 2015a May; 29(5):1317-28.

Ramírez-Campillo, R., Henríquez-Olguín, C., Burgos, C., Andrade, D.C., Zapata, D., Martínez, C., Álvarez, C., Baez, E.I., Castro-Sepúlveda, M., Peñailillo, L., Izquierdo, M. Effect of Progressive Volume-Based Overload During Plyometric Training on Explosive and Endurance *Performance* in Young Soccer Players. J Strength Cond Res. 2015b Jul; 29(7):1884-93.

Rampinini E, Impellizzeri FM, Castagna C, Coutts AJ, Wisloff U. Technical *performance* during soccer matches of the Italian Serie A league: effect of fatigue and competitive level. J Sci Med Sport 2009; 12: 227–233

Reilly, T.; Williams, M. Science and Soccer. 2ed. London: Routledge, 2003. 352p.

Rodrigues, HFM; Nakamura, año fiscal; Rabelo, FN Futsal: la ciencia de la preparación física. Porto Alegre: Secco Editora, 2019. 232p.

Strudwick, A.; Reilly, T.; Doran, D. Anthropometric and fitness profiles of elite players in two football codes. The Journal of sports medicine and physical fitness. 2002; 42(2): 239-42.

Styles WJ, Matthews MJ, Comfort P. Effects of Strength Training on Squat and Sprint *Performance* in Soccer Players. J Strength Cond Res. 2016 Jun;30(6):1534-9.

Turner, A.N. and Jeffreys, I. The stretch-shortening cycle: proposed mechanisms and methods for enhancement. Journal of Strength and Conditioning Research, 17, 60-67. 2010.

Velocidad en el fútbol: un panorama general. Universidad del Fútbol, 2008. Disponible en: https://universidadedofutebol.com.br/2008/11/05/velocidade-no-futebol-panorama-geral/#:~:text=No%20futebol%2C%20velocidade%20%C3%A9%20uma,e%20utiliza%C3%A7%C3%A3o%20das%20respectivas%20situa%C3%A7%C3%B5es. Consultado el: 05/01/2021.

Verkhoshansky, Y. Todo sobre el método pliométrico. 2. ed. Badalona, España: Paidotribo, 2016.

Walsh, M., Arampatzis, A., Schade, F., Bruggemann, G. The effect of drop jump starting height and contact time on power, work performed and moment of force. J Strength Cond Res 18: 561-566, 2004.