

## Module 2. The sports season

### Unit 2.1 Moments of the season

#### 2.1.1 Sports calendar

The sports calendar is determined by competitions, i.e. all those tournaments in which the team will participate during that season.

The first thing that a team must do when knowing the calendar is to prioritize according to its resources:

- 1) Priorities:
  - Ranking of competitions, determining on which to place more, or less, value.
  
- 2) Human resources:
  - Number of players that the team has.
  - Players that can be added.
  - How many players available per position.
  - Members of the coaching staff.
  
- 3) Material resources:
  - Sports facilities.
  - Means of recovery after game and training.
  - Feeding and supplementation system for the players.
  - Means of transport.
  - Lodging for visiting games.

The objectives and goals to be pursued in each of the competitions during the season will be considered depending on the availability of all these resources.

Training methodologies are affected depending on the evolution or modification of the sport calendars year by year. It is not the same to prepare a team for a competition that has one match per week, as for a competition that has three matches per week. It is no coincidence that the concepts or terms used in older training theories are related to physical condition growth as a result of increased loads (even in undulating load methodologies) by increasing the stimulus or external load, and that, on the other hand, today's training methodologies are basically controlled by the concepts of recovery, rest, transition. In addition, many of the training sessions point to the player recovering from the physiological and mental aspects of the previous game, analyzing and preparing the next game. It could be said that the mode of training or the maintenance of physical condition is the competition itself at certain times of the sports calendar.

In 2013, Paco Seirullo, together with Carlos Lago Peñas (2011) and other contributors, wrote an article about the objective causes of planning in team sports.



Here they suggest a series of perspectives to deal with training in what they call team sports. As a first step, there is an erroneous view on these sports when planning training, separating the physical (bioenergetic) aspect from the tactical technical (informational) aspect and approaching it from individual sports or sports based on times and records. This is analyzed as follows:

- Conceptualization and use of terms from individual sports.
- Use of methods and even training exercises from individual sports.
- Impossibility of quantifying the load value.
- Not observing the competition calendar when thinking about the training period.

Based on this, the authors suggest the following:

"The creation of theoretical knowledge from practice in each performance sport will be the basis of the performance methodology in that specialty. This will increase efficiency in practice and its knowledge".

This inevitably considers the inclusion of the competition calendar within training planning.

The competition calendar is defined here, adapting Matveev's (1985) definition of the sports training periodization as the chronological organization of the competitions, within a system in which its moments, number, order, and dates are determined in a specific period of time.

The type and length of the competition must be kept in mind in order to develop a more effective training program, adapting the workload to work fluctuations.

It is based on the fact that the match is the moment of greater specific psycho-biological load, which occurs in each training microcycle and can occur twice. This has a direct influence on the specific physical condition intended for athletes for most of the season. This is explicitly explained in the following sentence obtained from the analyzed work in question: The specific actions, executed with continuous adjustments and at specific speed, are cause and effect of the partial improvements' synergistic integration of the subsystems involved. Thus, the competition becomes the best way to evaluate the players physical condition in a synchronous way. At present, teams that have the resources to carry it out, use monitoring systems capable of very accurately determining the players physical performance and some tactical behaviors during the game, such as being able to control not only the performance in relation to the result, but also the load that the competition means for each player. This allows the training process to be constantly influenced by the data obtained in competition and vice versa.

On the other hand, but within the same work of Carlos Lago Peñas (2011), an analysis of each competition calendar characteristics was carried out.

From a general point of view, the sport calendar is considered as a tool of great importance in terms of instances of competition. On the one hand, in the training and initiation stage, the sports calendar is key for generating self-knowledge and improvement habits in the competition. On the other hand, in the specialization and performance stages, the match



or competition, considered as both an objective and content of the training methodology, are considered excellent means for the analysis of the players performance and physical condition, in order to feed back the process. Always with the main purpose of increasing the individual and collective specific physical condition as a path to success at the results level (although it does not ensure success).

So far, this was an analysis of the sports calendar's influence on training methodology. In some way, in the future, sports calendars should contemplate the laws and methodological principles of training and should be developed based on them. This will help improve performance and more effectively achieve the specific physical condition for both a particular time-table and in the long term; at player, as well as, team and club level.

### **2.1.2 Pre-competition period**

Also known as preseason, it is the moment in which the team begins to prepare for the sports season, after the period of transition or post-season. Here the team begins to train for the first time as such, taking into account that during breaks between seasons teams are usually modified. In addition, during that recess the players generally carry out individualized training programs, an issue that we will develop later.

Just as over time the programming or training planning theories and methodologies have evolved, so have the paradigms about their meaning and utility.

There are two ideas that have marked the preseason's existence over a long period of time. These are, on the one hand, the premise that a specific good physical condition must be sustained by a general good physical condition. Regarding this, we consider that the physical condition achieved through training and preparation, will be the support of the athletes' sports performance. Therefore, the latter will be a true reflection of training. It sounds illogical to expect that a general preparation, characterized by large volumes, patterns of nonspecific movements, little inclusion of technical and tactical contents, and more importantly, speeds and intensities lower than those achieved in the game, can be the basis that supports the team's sports performance during competition. This refers, as we see, not only to physical or conditional content, but also to factors that influence the players' and the team's tactical technical performance. And this is one of the key points that we will develop in this item, since we consider the team members adaptation and co-adaptation to the game model as the primary objective during this period.

On the other hand, there is the premise that the physical condition achieved during the preseason lays the foundation and is enough to participate productively during the rest of the season. However, the physiological basis indicates that adaptations generated during training cannot be maintained for such a period, and should be periodically stimulated (Pol, 2011).

Historically, the preseason started with high training volumes, meaning the total work time per exercise and session, and the distances covered. Then, over the course of days and weeks, these volumes were reduced and the intensities were increased, measured according to the average heart rate of the trainings and the speeds reached in the exercises. Also, the coaches had little contact with the team, since all the work was carried



out by the physical trainer, under the pretext of having to match the team players in order to be able to face training with proper tactical content.

Al Vermeil was the Chicago Bulls physical trainer during the 6 NBA titles won by Michael Jordan and Phil Jackson, the only physical trainer to win US national titles in the NBA, NFL and MLB. He states that with the arrival of the players for the beginning of preseason, the first objective is to increase the players load capacity, defining it as the ability to withstand the effort made during training with the premise that to endure it also means to be able to carry out the training that follows. Therefore, the players should be prepared to be able to carry out the training with increasing intensity and frequency.

This definition of load capacity, as well as the suggested work we will do for the pre-competitive period, are closely related to the idea we propose about endurance in team sports, which we will develop in the second unit of the module.

### **2.1.3 Competition period**

In team sports, the competitive period consists in the length of the competition, or in most cases, the sum of these competitions, since when participating in different tournaments with the same team, these issues have to be taken into account within this period when preparing the training process. This process will be completely determined by the frequency of competitions. For this reason, the new training methodologies take as a temporary basis the week or microcycle in training preparation, because the main competitions have one game per week, and the alternative competitions in which the teams usually participate often place matches within the week, as far as possible from the other matches.

That is, a team that participates in a local competition, will have one match per week, which may be on weekends. If that team participates in an international tournament, the matches of this competition will take place one day a week away from the previous and subsequent matches, enough time to promote the players optimal recovery, in order to avoid injuries due to exhaustion or overuse.

Historically, training in team sports was determined by objectives related to individual sports, or time and record, where the development of components related to sports performance was put forward separately and with isolated objectives and training loads.

At present, this paradigm has moved towards a state where training is thought and planned based on the sports calendar and, therefore, on the collective and individual performance of each sport or discipline in particular.

Therefore, and returning to the optimal time structure to develop the training process, the microcycle or week is the basis of the new training methodologies.



Here we will find different components depending on the objectives pursued, that we shall see next:

- Mental and physical recovery from the previous match.
- Focus on performance based on the game model.
- Possibility of development of new principles or sub-principles, both in offense and defense.
- Strengthening of weaknesses and correction of errors detected in previous matches.
- Load control to get to the next game in optimal conditions.
- Setting priorities based on the team's situation regarding the tournament, the rival or other competitions.

Rafael Pol (2011) refers to this in his book *La preparación ¿física? en el fútbol* [Physical preparation in soccer], where quoting Seirullo, he speaks of microcycles or WTC (weekly training cycles) as the optimal time unit to achieve an effective load control, arguing that managing load control in time units greater than WTC is meaningless.

The key basis of this proposal is, in the first instance, the number of variables that must be taken into account when scheduling the training and, therefore, the load, as the player, the team, the game model, the previous game and everything that surrounds these concepts. On the other hand, we know that we have a game every weekend during the competitive period, so the objective of the training process that week will be aimed at winning the next game.

It is difficult to schedule a match if we consider the load from a perspective of the work month or semester, which does not mean that we cannot keep track of the quantities and intensities used so far in extended periods of time. In fact, we consider that this is a very useful tool to become aware of how performance, both individual and collective, is fluctuating, in order to make decisions about the training process. But back to the point, those decisions must be included within the framework of the training microcycle.

#### **2.1.4 Transition period**

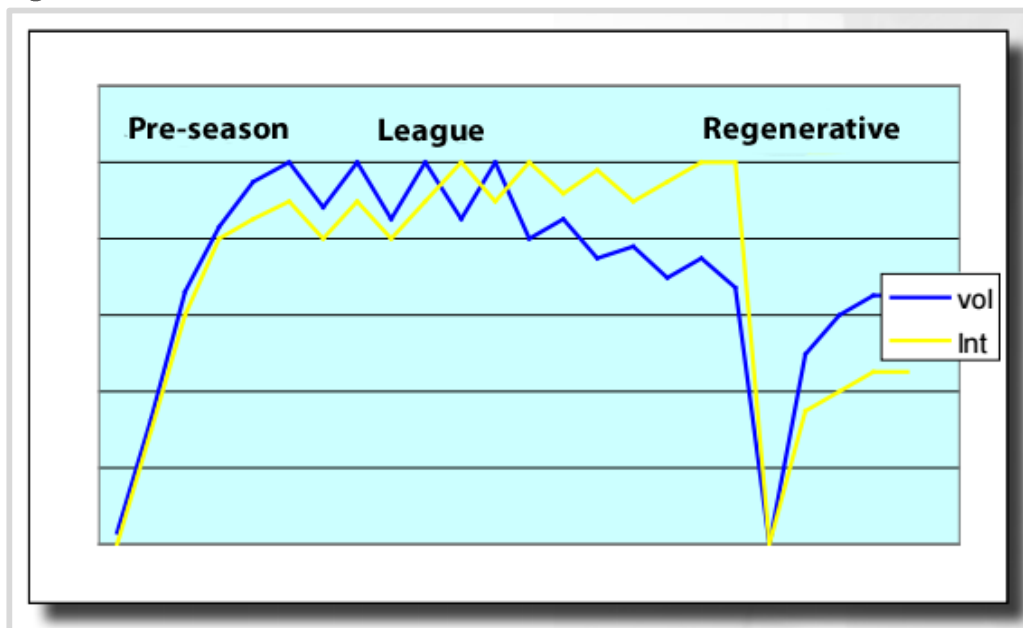
Solé (2008) considers the loss of specific physical condition and generic maintenance as an objective of this phase, differentiating two moments within the transition period which he calls Regenerative Phase:

- Complete interruption of load dynamics. We can call it a holiday period, which will depend on the characteristics of the previous and the next season, and it will also depend on the length of the same transition or regeneration phase.
- Increasing load dynamics with predominance of volume over intensity. The percentages of the load components will increase to approximate those stipulated for the first microcycle of the next preseason. This will prevent muscle overload in the first training weeks.



To end this unit, in the following figure we will show how load dynamics are distributed during the three moments of the season in a team sport such as soccer.

Figure 1



Source: Taken from: (Roca, n.d.) El proceso de entrenamiento en el fútbol [The training process in soccer]. Metodología de trabajo en un equipo profesional [Work methodology in a professional team].

The transition phase represents the union between two seasons. Its main objective is psychological rest, relaxation, physiological regeneration, and maintaining an acceptable state of physical condition. It is worth noting that it demands less effort to maintain a percentage of the physical condition than to develop it again completely (Bompa, 2016).

Arguably, this is one of the favorite times of the season for physical trainers. This is because it is a period in which there is no competition, therefore there is no time pressure from that point of view. Load control goes hand in hand with the need to be able to comply with trainings programmed for this moment, without considering the need to reduce the intensities or training volumes to be able to get to the weekend's match.

Here we should make an observation. The methodology under which the team or athlete works during this transition stage will be decisive. We refer to the possibility of developing under a biological or holistic tendency, as we saw in the first unit. It is difficult not to consider the possibility of breaking down athletic performance to work on only some of its components, or at least separately, without integrating them into the sport in question.

In this period, athletes generally work towards correcting weaknesses as well as strengthening virtues. In the case of soccer, the transition or post-season periods are usually shorter than in the case of basketball, for example. Therefore, they use this time for the recovery of injuries, pains, problems they may have carried during the competition, etc. Also, they train not to diminish their physical work capability, so as to get to the beginning of the preseason in optimal conditions. In this regard, Solé (2008) states that during this period there is a decrease in the maximum oxygen consumption in athletes, explained by the decrease in cardiac volume, due to the decrease in systolic volume. Coyle

(1984) stated that this is due to a decrease in aerobic enzyme activity and blood volume. Taking into account that the capillary status in athletes remains high, we could attribute this loss of  $VO_2$  max levels to decreased cardiac and enzymatic volume. For this purpose, Green et al. found that cardiac levels can be recovered after a few interventions at high intensities of  $VO_2$  max due to the rapid increase in blood volume as a result of increased plasma volume. The aerobic enzyme levels take a somewhat longer time to recover, but always in terms of activities that represent high intensities regarding the athletes' oxygen consumption capacity.

During the transition period, there is an obvious and inevitable load decrease. The benefits that strength gives to physical performance will be benefits as long as the neuromuscular system maintains the cellular adaptations induced by the training. When strength training stops, these qualities decrease as the contractile capacities of the muscle are lost. The consequence is the detraining, or a visible reduction of the force effect on the athletic performance (Bompa, 1999). According to this author, the Detraining process consists in the loss of adaptations achieved by the exercise. This effect occurs faster than the improvements in physical performance produced by training. We can add that the decrease of the force levels in its different expressions will be specific to the type of training that is eliminated for the athlete. Therefore, we recommend not to completely eradicate general or specific strength training during this moment of the season. On the contrary, we recommend a special focus on strength training.



## Unit 2.2 Development of skills and physical qualities

### 2.2.1 Endurance in team sports

Bearing in mind that the term endurance is intimately related to time, duration, great distances, to sustain an effort, to endure fatigue, we will now see some definitions of endurance that put us in the perspective of the relation between endurance and sport performance in team sports. To this end, we will see some definitions taken by Solé (2003) in the notes of "Endurance training in team sports of the high performance professional master in team sports"

- Bompa (1983): "It is the time limit on which work can be performed at a given intensity".
- Harre (1987): "Athlete's ability to endure fatigue".
- Weineck (1992): "Physical and Psychic Ability to endure fatigue"
- Manno (1991): "Ability to endure fatigue in long-term work".
- Martín et al (2001): "Ability to sustain a given performance for as long as possible".
- Platonov (2001): "Ability to perform an exercise effectively overcoming the fatigue that occurs".
- Bompa (2003): "It refers to the time during which a subject can perform a job at a certain intensity".

These are all definitions that refer to individual sports, where effort is constant. But in team sports there is a high intermittent content, where the players must constantly start and stop their motor patterns, runs and efforts. That is why the definition of Massafret (1999) is the one that Solé (2003) considers the most accurate or more related when it comes time to conceptualize the term of Endurance in team sports.

"The ability to withstand the physical, technical and tactical demands established by a particular play system during the match and the competition." (Massafret, 1999).

Here endurance does not have an objective in itself, but to collaborate with other physical qualities in order to be able to be performed effectively as often or as much time as possible.

In team sports, there is a constant requirement to combine slow actions with explosive or maximum speed actions, and thousands of combinations arise from this. In fact, this is why they are called situational sports.

Thus, the glycolytic system, both aerobic and anaerobic, is in constant operation and with alternating predominance between one and the other. The emptying of glycogen, the substrate that provides this energy system, will bring along fatigue situations that can cause, first, a decrease in physical performance, especially regarding the ability to maintain the quality and quantity of rapid movements necessary to participate in the game. And secondly, possible injuries resulting from the inability of the system to fuel the muscle, precisely because of its emptying (Solé, 2003).



## Endurance development

From the general point of view, the objective of endurance development is the following:

- Maintain a certain intensity of work.
- Increase the capacity to bare the training and competition loads.
- Favor rapid recovery after efforts.
- Stabilize the sports technique and the ability to concentrate. Regarding team sports, we could determine the following objectives:
- Withstand physical as well as mental exhaustion during time of play, the match, and throughout the season.
- Accelerate the recovery process between slowdowns, the game's micro- and macro-pauses, and between training and the match.
- Maintain the player's optimum performance level, in technical motor pattern execution and in decision-making.

Regarding endurance training in team sports, we will first introduce a compilation of different authors by Raya (2003) based on the proposals for endurance training in soccer.

- **Bangsbo refers to three ways to train endurance:** They are the following:
  - Recovery training: this takes place after a match or training of high energy demand, with the aim of restoring both psychological and physical capabilities. Smooth runs and moderate intensity games are the most common tools used in this type of training.  
The intensity will be 65% max HR, and intermittent work should exceed 5 minutes due to the low intensity of exercises.
  - Low intensity aerobic training: allows long duration efforts, as well as recovery after intense actions. The intention of this type of training is to prepare the athlete to meet the demands of the competition in terms of volumes and distances covered. Training will be of an intensity of about 80% max HR. If the exercises are intermittent, they should also exceed 5 minutes.
  - High intensity aerobic training: aimed for the athlete to maintain high physical intensity for as long as possible. It is also useful to improve the recovery between intense activities. The intensity of the exercises here will be 90% max HR. In this type of training it is important to keep the athlete below the anaerobic threshold so as not to lose intensity during long working times.
- On the other hand, Weinek tells us that the soccer player must be prepared for general and specific endurance. The first has more relation with the work, therefore its methodology will be determined mainly by the volume and not so much by the load high intensities. This precedes the specific endurance and is the base on which it develops later. This author states that levels of aerobic training should not overlap with the rest of the conditional capacities, i.e., excess endurance training with low intensity levels may result in a decrease in the subject's ability to perform explosive force effectively.



- Benitez and Ayestrán mark the development of endurance as determined by two major branches, aerobic endurance and aerobic power.

Here we will refer to the methodological proposal of endurance development by Joan Solé (2003).

- **General endurance training:**

It refers to endurance work that is not related to the sport being trained, from a technical and tactical point of view. Here we can differentiate the first-level work, where we find activities that do not even present the main technical motor pattern of the sport in question, such as swimming or pedaling for a handball player. On the other hand, second-level work, which comes a little closer to the athlete's main activity only at a technical level, but where decision-making and information processing situations are not yet included for element management purposes, which is a constant in all team sports. Here we refer to the running movement of a field athlete, whether big or small, or to swimming in the case of a water polo player.

Traditionally, it has been highly valued according to the time spent in this stage of endurance training in team sports. But with the adjustment of sports calendars and the training methodologies consequent adaptations, this has been lost.

#### **Fundamental causes of general endurance training**

- create the basis for extensive training, both technical and tactical;
  - increase the ability to withstand for a longer time the game's rhythm that is needed to participate in a match at high intensities;
  - improve recovery capacity, both in-game and in between matches and training;
  - reduce risk of injury due to fatigue or lack of rapid response to sudden situations;
  - improve mental capacity to withstand a prolonged effort; reduce the loss of technical and tactical performance due to fatigue;
  - have greater resilience between maximal exertions;
  - improve health.
- **Specific endurance training:**  
Here is where we ensure that the player not only develops the ability to withstand the physical loads of training or competition, but that is also able to pair them with the highest technical and tactical quality. This is why the author focuses on three key points for the development of specific endurance:
    - **Endurance training in technique:** here we aim to improve technical performances, not in isolation, but permanently considering the need for this to happen under real game situations.
    - **Endurance training in decision-making:** levels of concentration and attention are determining factors in the quality of decisions that the player makes during matches and training. Therefore, in this sense, the objective of endurance training will have to do with ensuring that the different intensities of the game situations do not decrease in the player or team's tactical performance.



- **Game endurance training:** we try to match what was developed in the two previous sections in real game situations through a competitive training method. This places the match itself as one more instance of training this type of endurance. In the case of training, always with a competitive or oppositional format, the difficulty and intensity are intended to be modified by changing the game rules, areas, or number of players. Its objective is to increase or reduce training intensity and difficulty and thus to influence the player's ability to participate in the game itself.

### **Optimization of specific endurance training**

The specific endurance training proposal is based on iterative and interval methods. A good way to increase training specificity is to replace rests with active recovery, with the objective of simulating what happens during the game. To this end, we must analyze which are the activities ranges, intensities and frequencies, both of maximum and moderate intensity during the matches of the competition to which our team belongs, and thus use them as parameters when developing activities.

It is worth noting that during the period of optimization of endurance, where the intensity of the exercises prevails over the volume, there are no decreases at the general physiological level. When the author refers to intensity, we must remember that it refers not only to physiological aspects of the game such as the average heart rate or the velocity of movement used in the exercise, but also to the quantity and difficulty of technical elements and decision-making that are present in the activities.

Based on the above, we will explain the iterative method of endurance training, which may be considered as the most appropriate regarding the specific endurance demands of team sports.

Briefly reviewing the traditional classification between endurance training methods, we find two major branches, which are the continuous method and the fractional method. We will draw from the premise that the use of continuous training for team athletes has practically disappeared. This modality differs from what happens in the game, not only from physiological aspects such as intensity, but also from the non-existence of technical or tactical components that are used in the game. Even the varied continuous training modalities, in which we find increases in speed or intensity, differ greatly from what happens in the field when practicing team sports.

**Fractional method:** in order to use higher intensities and working speeds during endurance training, it is inevitable to use pauses during training. Thus, the methods that correspond to the fractioned methods branch, use pauses in one way or another. These will be of the type and time demanded by the activity according to the exercise's objective and the requirement for complete or incomplete pauses. The nomenclature refers to interval method if the pauses are incomplete and to repetitions method if the pauses are complete. This refers to the recovery levels achieved by the athlete during breaks and the possibility to continue working at the same intensity and for the same amount of time as before the pause.



Within the fractional methods we find the iterative method, which could be defined as a superior evolutionary stage of the fractional method in the situational sports training. This is characterized mainly by the variation of the intensities and speeds used within the same work and series, and of course, the variation of the pauses both in type (active or passive) and in time. Therefore, the player will encounter a certain randomness when exercising that will prevent them from establishing a precise working and rest rhythm.

It is of vital importance that, to use this method, the trainer is clear about the most frequent work and pause times in at the different intensities that occur in the sport that is being trained.

This method considers the use of both technical and decision-making elements of the sport, since it is based on the theory of dynamic systems and, therefore, considers the game as a whole that cannot be achieved by separating its components, like the physical and the cognitive.

## **2.2.2 New training methodologies in strength development**

Without denying the importance of specific endurance, strength is undoubtedly the dominant ability in most team sports. Therefore, in order to avoid the loss of strength and power of our athletes, we must plan a strength maintenance program for the competitive period (Bompa, 1999). The author also emphasizes the importance of subordinating the intensity and strength volume work, to training load and competition.

Regarding strength training, something similar happens to the rest of the physical preparation areas in their inclusion in the team sports training process. Historically, the logical thinking was: if I want my athlete to improve speed, I employ a sprinter's training; if I want to improve endurance, I use a long-distance runner's training, and so on with all conditional areas.

In the case of the inclusion of strength training in team sports training programs, strength work was initially performed only in the weight room, using free weights or machines. From its beginnings, this conditional area has come a long way. Thanks to science and research, strength training methods could be adapted to the real sport needs of both team and individual sports. This has meant not only focusing on the loads used or the execution speeds of strength exercises, but also on the general and specific movement patterns of each sport, the lengths and characteristics of the motor patterns that demand high levels of explosive force and power. For example, if we perform 4 maximum repetitions (MR) of deep squats, we cannot expect to get the same results if we want to improve a volleyball shot or rugby tackle.

Perhaps the change has occurred at the philosophical level, in the transition from training the muscle or muscle groups as units force production to training athletic motor patterns characteristic of a particular sport.

Therefore, we must remember that these athletic motor patterns must be involved in a space and an adequate time for success in their execution during the game, and this is an element that has also influenced the philosophy and methodology of strength training.



In the case of shared field sports such as basketball and soccer, we have the component of the space dispute, which demands moments of strength against opposition. That is something that strength training in these sports should consider and put into play within the methodology. It would be inappropriate to assure an athlete that there will be an improvement in his or her field performance when competing or training only by training to improve their strength capacity in isolation.

Bosch (2015) poses a difference between a reductionist approach to strength training, in counterpart with one based on the complex systems theory.

The reductionist approach attempts to understand or explain situations by analyzing the sum of its parts. This clearly expresses what is said about how some training methods disaggregate the development of athletes in each of their conditional abilities.

Paco Seirulo Vargas (1993), speaks of a globalizing physical preparation, in reference to the fact that a certain conditional, coordinating or cognitive capacity can be more improved if it is trained in relation to other capacities, instead of working in isolation.

Returning to the complex systems theory, Bosch (2015) claims that there is no universal ability such as strength or power, because, for their expression, these qualities depend on athlete's coordination in situations of play, and therefore someone can be strong or powerful in certain areas but not in others.

Thus, comes the concept of Transference, so mentioned and used in strength training in team sports; the optimization of strength trained in the weight room for application in real game situations depends on this concept.

Here we must clarify that the Transference process is not only related to force application speed, but also to the movement patterns specific to that sport. This will determine the transference needs according to each discipline, not only due to purely mechanical issues, but also to the sensorimotor system. Since motor patterns and actions are learned due to obtaining a result through that movement and therefore giving it a significance, and not by the simple fact of executing a particular movement pattern.

One of the most frequently used training methods in team sports for developing strength and power are weightlifting derivatives (WLD). CHRISTOPHER J. SIMENZ (2005) interviewed different NBA team's strength coaches. One of the questions was whether they used WLD as part of their players' strength development, to which 19 of 20 coaches answered that they did. And most of them put WLD in first place, along with the Squat and its variants when choosing exercises to create their training programs. Finally, it is important to emphasize that all the coaches interviewed in this study use strength assessments to identify both collective and individual needs and thus be able to set goals for training programs.



### 2.2.3 Repeated sprint ability training

The concept repeated sprint ability as the name implies, basically explains the ability of an athlete to maintain performance in the repetition of explosive movements or with high power level demands, mostly short runs (under 10") of maximum speed in different directions and in their multiple variants. Combined with brief periods of time of mostly active pauses, which are basically the low intensity movements that occur between one sprint and another.

During an elite soccer match, the average speed race distance is between 10 and 20 meters and last between 2 and 3 seconds. This happens with a total of between 20 and 60 maximum runs for a distance of between 700 and 1000 meters. Evidence has shown that the ability to maintain performance in these types of actions over a period of time with high levels of power and speed can be a good predictor to differentiate athletes of different levels (Hoffmann, 2014).

This ability is key in situational sports, since it will be intimately related to the athlete's levels of endurance. This is because endurance in team or individual sports, such as tennis, is determined by the subject's ability to extend the quality of athletic motor patterns that lead to success, which always have to do with power, explosive strength, agility and speed, during the time demanded by competition, both the match and the championship.

With respect to the physiology of repeated maximum runs, we can say that the participation of glycogenolysis is limited, in part due to the increase in aerobic metabolism during runs. We can add that the length of sprints can significantly alter the relative contributions of one energetic system or another. The rate of degradation and resynthesis of phosphocreatine (PCr) will have a great influence on the performance subsequent sprints. This is because at greater degradation, longer time is needed for repletion (Bishop, 2005). In short, an individual with a better level of PCr resynthesis during sprint recoveries, or with better aerobic power, will have a better RSA.

Thus, by using exercise programs with repeated maximum runs, a subject's ability to repeat sprints can be improved. However, the unpredictable nature of team sports, makes it difficult to find a universal prescription, valid for most of these sports.

Meanwhile, if we consider the above, we must understand the importance of training technical aspects of short sprints and changes of direction, as well as of power through strength training. And that the improvements produced by these types of jobs will lead the athletes to their maximum athletic motor patterns with less effort and with a consequent saving of energy. This will indirectly increase the subject's RSA. The training of these mentioned aspects can therefore not only improve a subject's ability to perform maximum sprints, but to improve his or her ability so that the average speeds reached in the sprints during a game are high.

Regardless of this, we must not forget that aerobic power levels will allow the subject a certain ability to repeat sprints. Therefore, it is not advisable to prescribe RSA protocols to increase the athlete's aerobic power, but vice versa. We must ensure an increase in the subject's endurance levels to ensure that his performance repeating maximum runs is



successful and that this achieves an increase in his or her ability to maintain the power in each one of the runs.

We should not fail to mention the small sided games (SSG), since they are a tool used by team sports coaches, due to their similarity to normal competition conditions, reaching heart rate levels and metabolic effects similar to those of intermittent high-intensity training, for example. Therefore, if in addition to the effects produced by games on a conditional level, we understand that they also have a contribution from tactics, technique and strategy, in reality we should ask ourselves: Why NOT use them? Now, we must make sure that if we use small sided games in combination with other conditional training such as strength training, we can compromise the development of strength and power of our athletes, and at the same time we can produce high fatigue levels. Therefore, the strategy of training and competition load control that we have will be of utmost importance, when it comes to promoting the performance of our team.

Apparently so far, the RSA will be closely related to fatigue and the athlete's ability to recover or tolerate it (a factor that depends directly on the subject's physical condition) both during and after exercise. Especially in sports where the schedule is adjusted and there can be up to three or four competitions per week, as in basketball. Therefore, another important concept in order to achieve high performance levels in these sports is recovery and tolerance to fatigue.

In basketball, approximately one thousand actions of between two and five seconds are carried out per match. Therefore, it is clear that the greater capacity to repeat these types of actions with the highest possible efficiency and maintaining its quality will determine a greater athletic performance.

The main mechanisms that cause fatigue are the following:

- Depletion of substrates.
- Accumulation of metabolites.
- Increase in core temperature.
- Exercise-induced muscle damage.
- Hydroelectrolytic alterations.
- Modifications in branched amino acids.
- Free radicals.
- Depression of the immune system (Terrados, 2010).

## **2.2.4 Fatigue as a key component in the development of training programs**

One topic that concerns us all during the competitive period is fatigue. Fatigue is considered one of the main causes of low performance and injuries.

Jones (2016) Indicated that training and competition stress results in a reduction in physical performance, as well as significant post-exercise fatigue levels. Defining fatigue as the reduction of the athlete's basic level of physical and psychological functions prior to competition. The accumulation of fatigue can also lead to a state of overtraining, which



has a significantly negative impact on performance. This idea proposes notions about an athlete's general fatigue state. Let us now look at a more biological concept about fatigue during exercise: Difficulty maintaining required or expected strength levels (Edwards, 1983). This is why training loads must be adjusted frequently during the training cycle to increase or decrease the effect of fatigue on athletes, depending on the training phase in which they are in. If so, this ensures that adaptations and performance in competitions are as expected.

Regarding the particular features of team sports, in which the athlete practices infinite combinations of exercises and motor patterns that demand a state of physical condition adapted to this, it is difficult to think of separately empowering each of his or her conditional abilities to then combine them at the time of the game. So Gabbett (2006) proposes that tasks based on sports skills, or the so-called small sided games, used in order to improve both tactical technique and physical performance, increase tolerance to fatigue through the use of movement patterns typical of team sports in a competitive environment. This involves developing athletic performance without separating the physical condition from tactical behavior or technical executions. Therefore, the load of the training stimulus resembles that of the match. In this same study, the author found that athletes who participated in training based on reduced games, compared with those who participated in traditional training of conditional capacities, obtained, on the one hand, similar changes in their maximum aerobic power and agility, but greater gains in speed and muscle power on the other. This demonstrates that training methods based on reduced games produce improvements at the conditioned abilities level when evaluated separately. Based on the above, one might think that when training in conditions similar to those of the game, athletes could develop a greater tolerance to fatigue, or at least it would be more effective in evaluating its effect on their competition performance.

However, it seems that performance has a high psychological component, which would have a great influence on the increase and the reduction of the athletes' physical performance during game situations. Carlos Lago Peñas (2011) in collaboration with Paco Seirul.lo, among others, they attempted to determine the relationship between fatigue and performance in team sports. They started from premises such as the fact the frequency, the partial distance and the total volume of high-intensity displacements and sprints, are reduced in the second half of a soccer match. Taking into account that the situations that determine both success and failure in this sport, as in all situational sports, involve high intensities and speeds of both technical execution and displacement, we can infer that their decrease would be linked to a reduction in athletic performance. What should now be defined is if this decrease is purely and exclusively linked to physiological fatigue, or whether we should also take into account contextual variables, such as tactical and strategic factors, partial marker, match location, rival quality, and so on. This work argues that the decline in sports performance is not only due to physiological fatigue. For example, O'Donoghue and Tenga (2001) stated that the players of the team that is winning reduce intensity, allowing the team that is losing to take the lead in the game. Carlos Lago Peñas (2011) suggest that the physical performance of elite soccer players is conditioned by the contextual variables of the game and therefore the decrease in the distance covered at maximum and sub maximal speeds is not necessarily related to the increase of physiological fatigue.



On the other hand, this study tried to determine if the competition density, that is to say, the frequency with which a team plays during the competitive period, does or does not influence the performance, setting as a possible fatigue production factor the accumulation of matches played in a short period of time. In 2004, Ekstrand found that players who performed below expected levels during the 2002 soccer World Cup had played an average of 12 matches in the previous 10 weeks, unlike the, on average, nine matches played by those athletes who were above the expected performance during that tournament. About 65% of players who had played more than one game in the 10 weeks prior to the World Cup suffered injuries or decreased performance during the tournament. Carlos Lago Peñas (2011) and collaborators concluded, in a study on 172 players from 27 Spanish league matches, that the players physical performance was not influenced by the short recovery time between matches when they had another competition match on Tuesday or Wednesday that week. They could add that the intensities in which the distances were covered during the matches were influenced by the contextual variables. Finally, regarding this subject matter, in 2006 Lago concluded that the teams that played champions league games during the week did not suffer statistically a considerable influence on the result achieved. When referring to player performances during matches and not necessarily to collective performances, and demonstrating that the returns were not negatively influenced by participation in matches during the week, we conclude that it is not a necessary cause so as to require players rotation due to their participating in parallel competitions. As long as, of course, the training process adapts to this.

There is clearly an extensive relation between the workload that the athlete receives and their state of fatigue. Traditionally, the external load has been the main focus when it comes to load control and in the creation of most of its monitoring systems. That is basically the work that the athlete performs during a certain period of time, this being totally independent of the subject's conditions during that lapse. These conditions express the metabolic, physiological and psychological stress that the completed work generates in the athlete. This phenomenon, called Internal Load, will also be key in determining the total workload. In fact, the combination between external and internal loads will determine the subject's fatigue state. (Halson, 2014).

Measuring the external load of both training and competition through exercise monitoring systems is crucial in order to make a comparison and establish whether training loads actually cover competition demands specifically. This tool is also valid to detect, for example, which players cover more meters over a period of time and which reach higher intensities. (Fox, 2017) This author refers to external and internal loads as two concepts that cannot be considered independently, or at least separately they do not provide much information for the purposes of analysis. Thus, although the physiological responses will give us an indication of the energy cost produced by training, they cannot be manipulated or modified independently. To alter the athletes' physiological responses, the stimulus itself should be modified.

Gabbett (2016) explains that the athlete's individual characteristics, such as age, training and injury record, and physical ability; combined with applied external load and physiological responses to that activity, will determine the "result" of training. To give an example, if we apply identical training loads to two subjects with large differences in their individual characteristics, we will obtain totally different physiological responses. Thus, a



training stimulus may be appropriate for one athlete, but insufficient or overloaded for others.

In the case of the internal load, in the previously named study by Gabbett (2016) a session-rating of perceived exertion (RPE) is proposed. This means that each player must rate the training session from 1 to 10 depending on its intensity according to their perception of the effort. The value expressed by the player must be multiplied by the number of minutes that the session lasted, and thus we will have the RPE value for each of the subjects that participated in the training. The author states that in the case of soccer, when these "arbitrary units" range from 300 to 500 they correspond to "low intensity" training and those that range from 700 to 1000 correspond to "high intensity".



## References

- Bompa, T.** (2016). Periodización del entrenamiento deportivo [Periodization of Sports Training]
- Dantas, E. H. M.** (2003). A prática da preparação física [A practice of physical preparation]. 5th ed. Rio de Janeiro: Shape.
- Grosser, M.** (1992). Entrenamiento de la velocidad [Speed Training]. Ed. Martínez Roca, Barcelona.
- Massafret, M.** (1998). Preparación física en los deportes de equipo [Physical preparation in team sports]. Unpublished
- Matveev, L.** (1985). Fundamentos del entrenamiento deportivo [Fundamentals of Athletic Training]. Lib Deportivas Esteban Sanz.
- Ossorio Lozano, Fernández Sanchez** (2011). Orientaciones sobre la psicología del deporte [Orientations on the psychology of sport].
- EFDeportes.com**, Digital Magazine. Buenos Aires, Year 16, No. 163
- Ozolín.** (1983). El entrenamiento en el sistema contemporáneo actual [Training in the current contemporary system]. La Habana: Científico Técnica
- Rafael Martín Acero, F. S.-I. V., Carlos Lago Peñas and Carlos Lalin, & Novoa.** (2013). Causas Objetivas de Planificación en Deportes de Equipo (I): Estado de Forma y Calendarios [Objective Causes of Team Sports Planning (I): Physical Conditions and Calendars]. Rev Entren Deport. 27(1).
- Roca, A.** (n.d.). El proceso de entrenamiento en el fútbol MCsports [The process of training in MCsports soccer].
- Seirullo, F.** (1993). Classification of endurance in team sports. Master en Alto Rendimiento Deportivo [Training planning in team sports. Master in High Performance Sports]. Madrid: C.O.E.-Universidad Autónoma de Madrid
- Siff, M. C., Verkhoshansky, Y.** (2002). Superentrenamiento [Supertraining]. Paidotribo, Spain.
- Solé, J.** (2003). Entrenamiento de la Resistencia en los deportes colectivos. Master Profesional en Alto Rendimiento. Deportes de Equipo [Endurance training in collective sports. Professional Master in High Performance. Team sports].
- Tamarit, X.** (2007). ¿Qué es la periodización Técnica? : MCsports [What is Technical Periodization? : MCsports]



**Verkhoshansky, Y.** (1996). Componentie structtura dell'impegno esplosivo di forza [Component structures of the explosive force engagement]. Rivista di Cultura Sportiva. Year 15. 34:15-21

