

PHYSICAL PREPARATION OF THE MODERN ELITE FOOTBALL PLAYER

FOR DOMESTIC AND INTERNATIONAL COMPETITIONS WITH SPECIAL REFERENCE TO CONGESTED FIXTURE PERIODS

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INTRODUCTION

Throughout the past three decades there has been a shift towards systematic multidisciplinary methods of preparing elite players for match-play. Contemporary coaches are better educated and have been exposed to scientific approaches to preparing teams for competition. In general, teams that have adopted a data-driven strategic approach have been rewarded by gaining an advantage over competitors. Evidently, there has been a paradigm shift in contemporary High-Performance sport. This shift has resulted in better-informed practitioners working with teams, stronger links with scientific institutes and more coaches being willing to accept the changing role of sports science in elite sport.

The physiological demands on modern

players are more complex than in many individual sports and these demands on players vary, depending on the level of performance, positional role and style of play incorporated by a team^{1,2,3}. Within the past few decades, there has been increasing emphasis on work-rate during elite competitive play^{2,4,5}. The modern game also includes more passes, runs with the ball, and technical actions, which collectively suggest a significant increase in the 'tempo' of games. The increased physical demands of elite football, in accordance with an increase in the total number of games per season at club and international level, are placing increasing physiological demands on elite participants. As these demands increase, player safety and well-being are also being challenged. A recent study revealed that

many professional players feel they are required to play too many matches and their recovery, performances and health are impaired, specifically during international competitions with excessive travelling⁶.

On average, elite male football teams participate in approximately 230 training sessions and 60 competitive games over a season⁷. This equates to approximately 20 training sessions and 5.5 matches per month, yielding an average training : match ratio of 3.7 training sessions per match. However, these figures represent seasonal average values and there will be periods throughout the annual calendar where elite players are exposed to matches every 3.3 days over a 5-game period. When one factors in disruption caused by the confounding variation in kick-off times, travel

TABLE 1

<i>Date</i>	<i>Kick Off Time</i>	<i>Opposition</i>	<i>Venue</i>	<i>Competition</i>	<i>Hours from End Previous Game</i>	<i>Whole Days Between Games</i>
Sat 20th Nov	17:30	Arsenal	H	Premier League	(Internationals)	3-4
Wed 24th Nov	20:00	Porto	H	Champions League	96.5	3
Sat 27th Nov	15:00	Southampton	H	Premier League	65	2
Wed 1st Dec	20:15	Everton	A	Premier League	99	3
Sat 4th Dec	15:00	Wolverhampton Wanderers	A	Premier League	65	2
Tue 7th Dec	20:00	AC Milan	A	Champions League	75	2
Sat 11th Dec	15:00	Aston Villa	H	Premier League	91	3
Thu 16th Dec	20:00	Newcastle United	H	Premier League	103	4
Sun 19th Dec	16:30	Tottenham Hotspur	A	Premier League	66.5	2
Wed 22nd Dec	19:45	Leicester City	H	Carabao Cup	73	2

Table 1: Sample of Liverpool FC Fixtures During Season 2021/2022¹⁸.

commitments and international fixtures it is evident that the current demands on elite football are intensive.

Several studies have evaluated the impact of fixture congestion on injury occurrence and physical performance output^{8,9,10,11} and have come to a similar consensus that, whilst physical performance, measured using player tracking technology, appears not to be affected, an increase in the number of injuries has been reported. Dupont et al.⁹, examined the effects of 2 matches per week on the physical performance and injury rate in male elite football players. Physical performance, as characterized by total distance covered, high-intensity distance, sprint distance, and number of sprints, was not significantly affected by the number of matches per week (1 versus 2), whereas the injury rate was significantly higher when players played 2 matches per week versus 1 match per week (25.6 versus 4.1 injuries per 1000 hours of exposure).

Clearly, the intensive training and frequency of competitive matches in elite football induce a high degree of stress upon the player. In a systematic review conducted by Silva et al.¹², it was concluded that 72hr of recovery from a match was

not long enough to restore homeostasis in all players. Therefore, the application of scientific support models, informed planning and execution of training plans have a self-evident part to play in improving elite performance whilst mitigating the risk of injury in participants.

Whilst it is difficult to objectively measure the direct impact of improving the physical capacity of players on overall performance, there is strong evidence indicating that injuries have a detrimental impact on team success with implicit financial losses^{13,14,15}. Thus, it is hardly surprising that, in addition to improving the quality of training facilities, considerable investments have been made by clubs in the recruitment and upskilling of modern well-educated practitioners, the so called, team behind the team. Increasing the size of the multidisciplinary team behind the team working directly with the players at a club, however, has also brought new duty of care challenges to organisations¹⁶.

The growth of the level of scientific support offered by professional clubs has also been emulated in international teams. Although there are similarities in the approach used by practitioners to

prepare players for club vs international competitions, there are also important considerations that need to be made, some of which are highlighted and discussed in the following text. Communication between practitioners working at club level and those working with international teams is essential to ensure that the health, well-being, safety and readiness to perform of the players is optimised.

DOMESTIC PREPARATION

From a sports science perspective the fundamentals remain the same regardless of the level of competition at the senior level, namely, to enhance the athleticism of players and optimise their readiness for competition, whilst minimising the risk of injury. The challenge is to do this at the elite level whilst preparing for and competing, as a squad, in potentially 60+ domestic fixtures. This is further compounded by international commitments, that players have which can add a further 10+ games a season to their football calendar even without a major tournament.

Congested fixture periods are the norm for elite clubs. This is what players need to be prepared for as they develop with the

successful clubs generally having players that can cope with this level of competitive exposure. Some respite may be granted for players during international breaks, but this is at odds with the objectives of many national teams who are striving to achieve qualification for international tournaments.

The example of Liverpool FC in Table 1 spans a period of 33 days during which 10 competitive games were played, resulting in an average of 3.7 days between them. With the added challenge of travel, the time available between games is limited, however there are several key elements that deserve consideration from a sports science perspective and subsequently acted on in the days prior to the next game.

Single game week micro-cycles tend to incorporate various elements of recovery and conditioning with a period of tapering leading into the subsequent game⁹. With the need to also integrate technical and tactical components, through appropriate planning this can be achieved over a 5-6 day period and sequenced as depicted in Figure 1. There are likely to be variations with regards to the specific focus on certain days based on the periodisation plan adopted, however, generally tactical elements are incorporated towards the end of the week accompanied with a reduction in load, whilst some elements of conditioning will take place after an appropriate recovery period that is influenced by the previous game demands.

For each phase of the microcycle, the tactics applied in support of the strategic plan will vary depending on numerous elements, these having been presented previously²⁰. It should be emphasised that there will always be a requirement to carefully consider the needs of players at an individual level in all elements of the plan, including those related to recovery and off-field conditioning, these being beyond the scope of this article. Recently, in a study on professional players, Garcia and colleagues demonstrated that the total load for players not involved in competition fell below those that are competing during both congested and single fixture weeks²¹. It is apparent therefore, that the field-based training elements are of critical importance through congested fixture periods in ensuring that when required to do so all players, not just those that are regular starters, can execute the tactical plan with no limitations due to physicality.



Figure 1: Microcycle Strategies and Phasing Between Competitive Games.

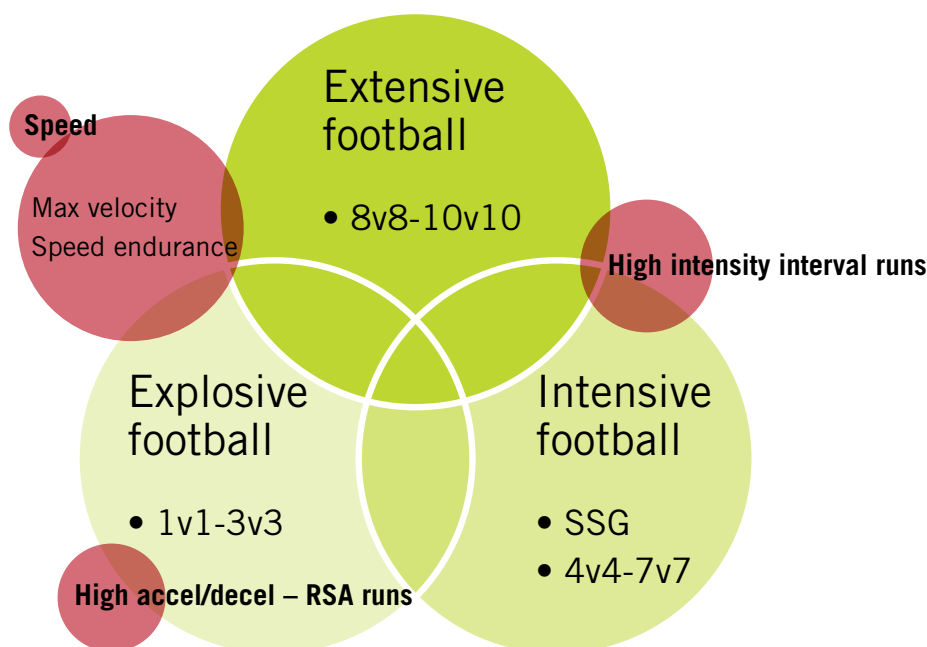


Figure 2: Conditioning Elements Associated / Combined with Typical Football Practices.

The categorisation of specific conditioning elements in conjunction with typical football practices helps in formulating a plan that can either use purely football drills, running drills or a combination of the two to produce the necessary load on players. Adapted from Walker and Hawkins²⁰, Figure 2 provides an overview of the physical elements commonly associated with the various football themes implemented in a training session.

Where there is no mid-week game, timing is less of a limitation to being able to provide the necessary stimuli during the week, with all elements represented in Figure 2 being potentially targeted. It is during congested fixture periods when it becomes more challenging to achieve this; there is a need to prioritise specific elements on certain days whilst not neglecting the time required to recover optimally for the next game. Table 2 provides an overview of the options for the various turnaround scenarios that are evident in Table 1.

A key decision concerns the work deemed necessary for the players on a match day that have had minimal or zero minutes. When there are only 2-3 days available between games this is an ideal opportunity to expose players to some high velocities or shorter explosive bouts. Where there are 4 days between games the decision is likely to be influenced by whether the team is being given a day off the following day or not; if they are, then there is an opportunity to target elements based on individual needs, whereas if players are due to train on a G-4 day the session is likely to be a significant conditioning stimulus and therefore it is not necessary to expose players to additional load that could compromise the subsequent session.

There are many variables that are considered at such times that could influence the decision to work after a game or not, some being more to do with psychology rather than physiology, however by creating a culture with a high work ethic and an understanding of why work

TABLE 2






Scenario	Game / Subs		Day 1	Day 2	Day 3	Day 4	Day 5
1	Game		G+1/G-2	G+2/G-1	Game		
2	Game		G+1/G-3	G+2/G-2	G-1	Game	
3	Game		G+1/G-4	G+2/G-3	G-2	G-1	Game
	 Speed / extensive	 High accel-decel / explosive &/or intensive	 Reduced volume explosive / intensive	 Tactical / technical	 Reduced volume tactical / technical		

Table 2: Example Training Themes In-Between Competitive Games.

TABLE 3

Player Categorisation	Game Density (days per game (DPG))	Priority
Selected for most games	<5	Recovery
Regularly rotated in and out – levels 1 and 2	5-12 12-21	Individual needs / maintenance
Rarely starts	>21	Extensive conditioning

Table 3: Categorisation of Game Density for Players and Physical Priorities.

at this time is needed, this aspect of the training plan plays a significant role across the course of a season. The importance of providing this stimulus is further supported by the work of Anderson and colleagues who reported that it was the lack of game time in Premier League players that was the significant contributor to the lower volumes of sprinting in fringe players and non-starters over the course of a season²²; this post-game top-up session is often the best opportunity for speed exposure to be achieved, especially if players could start in the next game within 2-3 days. Buchheit²³ presented a remediation strategy to help maintain high-speed running load via high-intensity intermittent running and has also proposed a concise decision tree framework of high-intensity running to support the between match training puzzle, accounting for many elements highlighted in the current discussion²⁴.

The scenarios presented in Table 2 imply that the targeting physical elements

becomes less of a focus in the 2 days leading into a game. Due to the time constraints highlighted, knowledge of the match readiness status of individual player's assist in formulating a plan of how to manage them appropriately. Elements such as player age, playing history and injury history help build profiles of players and enhance a club's understanding of their ability to cope with congested fixture periods, this all being part of the craft knowledge of specialists within clubs. Predominantly, across a fixture period similar to that presented in Table 1, players tend to fall into one of three categories, the priorities for each group of players being markedly different from a conditioning perspective (Table 3). Utilising the individual playing minutes from the schedule in Table 1, it is evident that the majority of players competing are at a days per game (DPG) status of <12 on a match day (Figure 3), with only 4 outfield players reaching a high threshold game density during the period selected.

The DPG figures are not only useful in supporting the plans developed for the non-starters in the group, but also at the other end of the scale in monitoring those players under a high game density load for extended periods. This is where an understanding of a player's individual history is important in helping to inform which players are going into 'unchartered territory' from a match load perspective and require a greater focus in terms of recovery and even possibly squad rotation (Figure 4). At this juncture it should be acknowledged that if a player has not experienced such a game load previously it does not necessarily mean he cannot cope, however knowing this will help in ensuring the DPG status is not missed in the multi-disciplinary team discussion on player management.

Being able to view profiles of players in this manner and have knowledge of which players have experienced and subsequently demonstrated that they can cope with the demands of competition whilst at

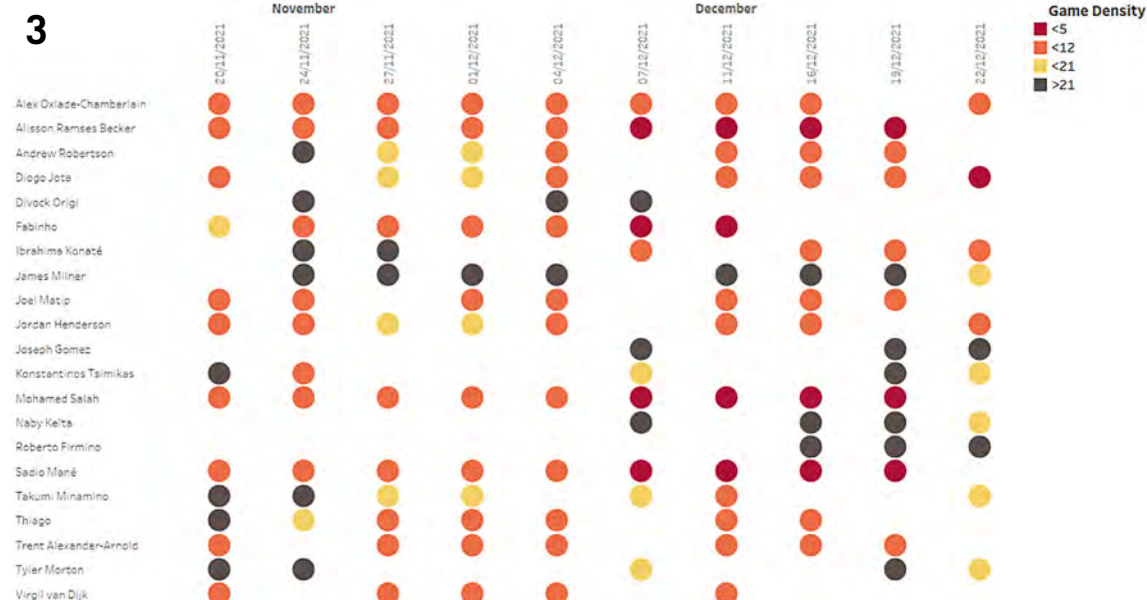


Figure 3: Time series chart representing an individual breakdown of playing exposure and game density status during Liverpool FC's fixtures that span from 20th November 2021 to 22nd December 2021¹⁵. *Game density status=21(rolling 21-day playing minutes/90). Note: players who only made one appearance during this period are excluded from the chart.

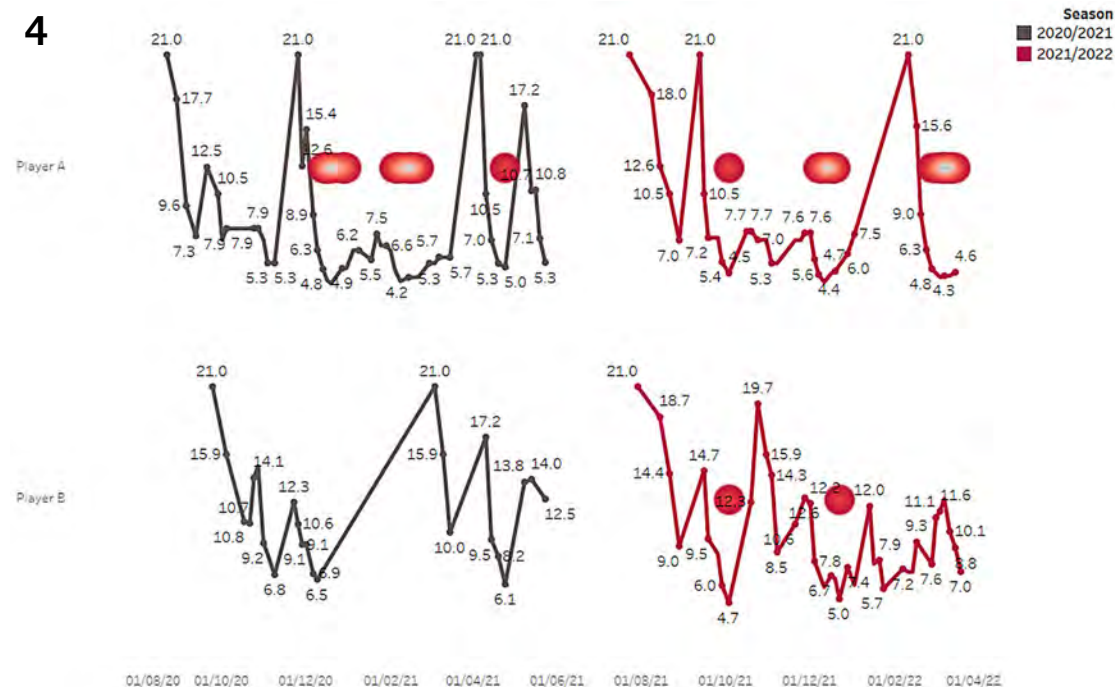


Figure 4: Longitudinal chart representing the playing exposure and game density status of two individuals across season's 2020-21 and 2021-22. As can be seen across the two seasons in question, Player A has endured numerous extended periods at a high game density status, whereas Player B has entered 'unchartered territory' twice in season 2021-22, while having reduced playing exposure in the previous season. *Red density circles represent instances where player has achieved a game density status of < 5 in consecutive games.

a DPG level <5 is beneficial for not only the management of players but can also support in decisions around recruitment, as well as helping inform national associations of player capabilities who, in turn, have their own fixture congestion challenges.

INTERNATIONAL PREPARATION

The focus of international football is exclusively High-Performance. In this context, High-Performance is competition at the highest level of participation, where the emphasis is on winning and success. Therefore, a performance support model needs to be well informed and deliver

high-level results. As a sports scientist working at this level, the critical areas of focus include:

- Ensure the team(s) are physically prepared to compete successfully during major tournaments
- Maximize selection of players for every competitive game
- Create concepts that reflect the Federation's approach to training and preparation
- Facilitate high levels of motivation and organization during training
- Create a performance model that satisfies the needs of all stakeholders,

including players, coaches, and staff

- Ensure close communication and liaison with clubs

With countless variables influencing success at elite-level international match-play, sports scientists must appreciate how their players will be challenged during competition. Indeed, international football presents a unique set of challenges. These challenges must be appreciated, confronted, and quantified for football success. An example of some of these challenges are presented in Table 4.

The physical requirements at international level vary from match to

TABLE 4

<i>Key Challenges</i>	<i>Factors</i>
<i>Environment</i>	<i>Events played at environmental extremes</i>
<i>Nutrition</i>	<i>Diverse range of individual nutritional requirements</i>
<i>Immunity</i>	<i>Travel, exercise, and tournament stress</i>
<i>International fixtures</i>	<i>Multiple fixtures during major tournaments</i>
<i>Tactics and systems of play</i>	<i>Changing demands of international play</i>
<i>Contact time</i>	<i>Reduced preparation time with players</i>
<i>Lines of communication</i>	<i>Managing communication with clubs and players</i>
<i>Club v Country priorities/agendas</i>	<i>Managing requirements of club and country</i>
<i>Individual player requirements</i>	<i>Tailored training v generic team training</i>
<i>Individual player differences</i>	<i>Managing players with different periodization plans</i>
<i>Head coach communication</i>	<i>Making sure Head coach receives information</i>
<i>Load management</i>	<i>Create an efficient strategy to manage load</i>
<i>Identifying player readiness/freshness</i>	<i>Need to quickly establish the status of players</i>
<i>Information sharing</i>	<i>Ensuring close communication with clubs</i>

Table 4: Key Challenges at an International Level of Competition.

match, depending on playing style, tactical organization, and location of the match. Football players at international level are regularly called on to travel large distances to participate in competitive games. Although international travel is routine for many elite performers, it is not without issues for the travelling player, a circumstance that should be recognized and managed by support staff. When journeys entail a two-three-hour time zone transition and a short stay (two days), staying on home time may be feasible. Such an approach is useful if the stay in the new time zone is three days or less and adjustment of circadian rhythms is not essential.

The key is planning and advance preparation. By doing so, player health can be maintained and negative influences on physical performance can be minimized. Players and teams that do not plan will approach international competitions with inadequate preparation and will be less

likely to achieve a successful outcome. To give the reader an appreciation of the complex demands placed on elite performers, Table 5 provides an overview of an international team competing in a FIFA World Cup play-off and The UEFA Nations League summer 2022.

In line with the above scenario, the preparation and training plan must be well organized considering individual differences, physiological capabilities and diversity of periodization templates athletes are exposed to at their respective clubs. A system of continual monitoring is essential to ensure that all athletes perform the required volume, intensity, and frequency of training. Training load should be prescribed to ensure optimal team preparation for the upcoming fixture, but also based on each individual athlete's previous training history and current physiological status. Careful planning between the coach and sports scientist will allow the training

process to be maximized reducing the risk of injury occurrence or overtraining.

At an elite level of participation, the coach builds co-operation between sports scientists and football players. Moreover, the coach with sports science guidance assimilates information, analyses the effectiveness of the training plan, and constructs the training sessions. Planning, decision making, monitoring and performance analysis all depend on the availability of the necessary information. Prior to arrival on an international training camp, sports scientists collaborate with host clubs to share data on players' physiological status. This information provides the platform to drive discussions and make informed decisions to maximize individual and team preparation. Although situational variables such as quality of opposition, game location and congested fixture periods must be taken into consideration, key performance insights may be identified.

TABLE 5							
Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	<div></div> <div></div>	<div></div>	<div></div> <div></div>	<div></div>	<div></div>	<div></div>	<div></div>
2	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
3	<div></div> <div></div>	<div></div>					
<div></div> Game <div></div> Training <div></div> Travel <div></div> Recovery							

Table 2: Example Training Themes In-Between Competitive Games.

INTERNATIONAL CHALLENGES

In the above scenario, 5 competitive games are played in 14 days where players are exposed to matches every 2.8 days over a 5-game period. In addition, two of the above games are played at away destinations requiring European flights. To add greater complexity to the scenario, multiple players finish domestic League fixtures at different time-points, meaning a one-size approach to training and preparation is not possible.

When planning for international fixtures a ‘Tactical Preparation’ methodology is recommended to control training variables and maximize tactical input from the coaching staff. This will allow for multiple scenarios, diverse individual management strategies and tactical planning. Key facets of a Tactical Preparation methodology include:

- All football training decisions are based around tactical preparation.
- There should be a direct relationship between practices and the tactical emphasis of the upcoming fixture.
- Weekly training pattern with alternating loads and complexity to cope with recovery demands.
- Always combining tactical principles and physical components in training.
- Managing the physical components and tactical complexity to ensure the recovery from previous sessions.
- Practices designed by manipulating constraints such as time, space, number of players and rules.
- Practices designed so that their specific requirements (tactical, physical, mental) are higher or lower than game.

- Recognizing that the concept of periodization is non-linear, and an individual approach will be required.
- Adopting an agile approach to planning and decision making where complexity is embraced.

The Tactical Preparation methodology shares many of the concepts defined in The Tactical Periodization approach²⁵, where a framework is provided to organize training sessions to create ‘actions’ that players expect during the next competitive match. Here ‘principles’ and ‘sub-principles’ of the different phases of the game are delivered to the players over different types of training sessions (Intensive, Extensive, Speed and Reaction). This methodology does not separate any component of the game model (physical, technical, tactical, and psychological) and is delivered as an integrated approach to preparation. The consistency and knowledge of workloads during each of the training sessions means that two important principles can be applied, namely, the principle of specificity and the principle of horizontal alternation.

The principle of specificity relates to training sessions designed to replicate

situations of the game to improve the decision making of the players. The principle of horizontal alternation relates to weekly training patterns with alternating loads and complexity to cope with recovery demands. Moreover, it is necessary to develop levels of play with organization by varying the complexity of the training throughout the week. To do this, it is necessary to horizontally alternate the type of dominant contraction of the muscle, such as tension, duration, and speed. An example of an international working week incorporating the principle of horizontal alternation is presented in Figure 5.

To optimize player freshness and maximize performance in competition, players exposed to a Tactical Preparation approach are exposed to different stimuli daily, thus avoiding monotony and/or overwork. The inclusion of low-intensity and recovery training will help achieve this aim. In practice, the weekly training plan is dictated by several variables including, current physical status, load coming into the training camp, number of games and individual differences. Therefore, a logical approach is to include flexibility in the training plan and tailor weekly templates to the specific requirements of the team and individual.

SUMMARY

The modern professional football player needs to be physically prepared for matches played at a higher tempo and more frequently than ever before. It can be argued that player safety and well-being are now being seriously challenged. Therefore, the application of scientific support models, informed planning and execution of training

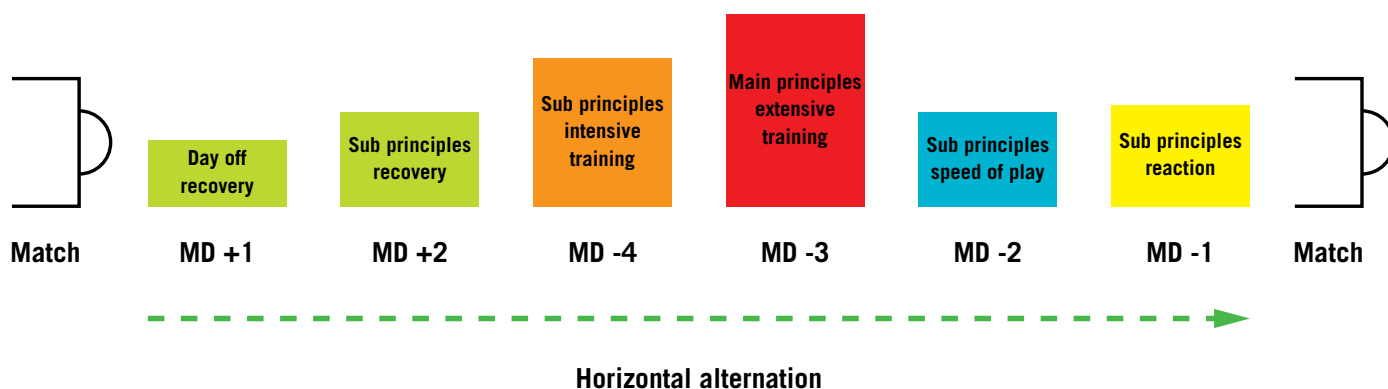


Figure 5: Example of an International Working Week.

Where:

Intensive Training – Reduced number of players, short-medium duration (1.5 - 6 mins), greater mechanical load than match, greater match density of actions. Soccer examples - 1 v 1, 2 v 2, 3 v 3, 4 v 4, 5 v 5.

Extensive Training – Increased number of players, increased space, long duration (> 8 mins), maximum velocity bouts. Soccer examples - 7 v 7, 8 v 8, 9 v 9, 10 v 10.

Speed of Play – repeated short explosive actions - pressing, transitions, possession practices, transfer games, mixed SSG formats.

Reaction – Reduced game duration (2-3 mins), restrained space - high numbers in smaller spaces (e.g 7 v 7 in 40m x 30m). soccer examples - 7 v 7, 8 v 8, 9 v 9 in small spaces.

plans, are vitally important in not only improving performance but also ensuring player safety and well-being. Modern practitioners working with professional clubs and international teams need to be well educated and coaches need to accept the important role that sports science now has in professional football. Although there are similarities in the approach used by practitioners to prepare players for club vs international competitions, for example a High-Performance support model needs to be well informed and deliver high-level results, there are also important considerations that need to be made, some of which have been discussed in this text. For those players who are selected to represent their country for international competitions, practitioners should ensure that there is close and detailed communication and liaison with clubs. In conclusion, the physical preparation of a modern professional football player is the job of a well-educated multidisciplinary

team and should wherever possible be evidence-based, with the ultimate aim of gaining an advantage over competitors whilst fortifying player well-being and safety.

References

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