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The Annual Training and Competitive Calendar In Elite Football: A Road To The Holy Grail?

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ABSTRACT

Organisations governing football codes worldwide continually seek to optimise the balance between their match calendar and commercial revenue. For many competitions, the result is more matches and, consequently, increased workload and travel demands for players. However, as competitions expand, the greater volume and/or intensity of workload challenges coaches' best practices in balancing performance with recovery and injury risk. This current perspective article aims to overview the annual training and competition calendar of professional football codes and competitions internationally. There is a vast difference in the length and structure of each component of football macrocycles, which appears dependent on the physiological capabilities required to compete in each code successfully. However, there is little research to justify the season's structure of any football code. The importance of athlete physical and mental health is highlighted, and discussed the limitations and restrictions governing bodies implement to protect players. In conclusion, future research to improve the structure of the annual training and match calendar should incorporate a framework of both physiological and psychological components to support elite football athletes better.

INTRODUCTION

Football codes worldwide are continually evolving into faster, more intense and more competitive games, increasing physiological and psychological workloads (17, 48). Sports categorised as football codes typically include European football (soccer), rugby union, rugby league, American football (gridiron), and Australian rules football. The increase in workload is concerning as athletes compete in more competitive games each year, primarily driven by the commercial demands of professional sport (36). Consequently, there is a need to advance best practices to augment performance and recovery, while also minimising injury risk (40). To address the issue of excessive workloads on professional football athletes, sporting organisations have implemented notable schedule restructures and enacted regulations to limit their workload (29). These actions have been taken to recognise the potential negative consequences on athlete health and performance. The need to critically review match calendars in professional football (soccer) has previously been highlighted (30). Importantly, however, professional football's annual training and match calendar differ considerably worldwide, making it challenging to compare codes.

Limited research has investigated or summarised the annual training and competitive calendar of different professional football codes, which may be beneficial when sporting governing bodies discuss competition structure and legislative changes. Recently, the increased workloads in European football have caused concern, with some athletes being pushed to extreme limits and expressing their negative perspectives on the current match calendar (26, 30). For example, in the extreme, elite soccer player Heung-Min Son played 78 games (53 club and 25 national) between May 2018 and June 2019, with 72 games played with less than five days' rest and involving over 110,000 km of travel. Accordingly, the present current perspective article aims to overview international professional male football competitions' annual training and competition calendar. Furthermore, the present piece aims to highlight consistencies, differences, limitations, and restrictions established by governing bodies regarding the training and competition calendar. Finally, this overview may provide a framework to facilitate practical advances in high-performance coaching, and provide direction for future research focused on progressing competition structures in professional football that improve athlete welfare.

PRE-SEASON PERIOD (ATHLETE PREPARATION)

For this article, the pre-season is defined as the period between the first official training session following an off-season transition period from the former season to the current season's first competitive match. This includes any pre-competition friendly/practice/trial games. The pre-season aims to prepare athletes physiologically, technically, mentally, and emotionally, for the upcoming season (40). To do so, the pre-season usually consists of a general and specific preparation period designed with the guidance of performance staff (i.e., coaches, high-performance managers, strength and conditioning coaches, sports scientists, physiotherapists/rehab specialists).

Length and structure

Pre-season length varies between football codes, individual clubs and athletes, with most organisations implementing a staggered return to pre-season training depending on the athlete's age and experience. That is, athletes who have played more seasons tend to report a week to a month later after their less experienced teammates. However, in rugby league competitions, such as the

National Rugby League (NRL) and Super League Europe (SLE), the return date is often impacted by international duties, which results in a delayed pre-season start date for representative athletes. As a result, the length of pre-season is vastly different between football codes (Table 1). For example, athlete preparation is as little as 4- to 6-weeks in English Premier League (EPL) football, where pre-season competition games may occur after as little as two weeks. In contrast, rugby league (NRL) and Australian rules football (AFL) pre-seasons are often spread over 12- to 16-weeks (inclusive of Christmas/New Year break). However, in the English rugby union (Gallagher Premiership Rugby) and Super League Europe (rugby league), the average time spent preparing athletes for the upcoming season is approximately 10- to 12-weeks. The preparation time for representative athletes is often reduced due to external representative commitments. However, English rugby union athletes require a mandatory 5-week post-season rest period (two weeks absolute rest and three weeks active rest) and a 5-week pre-season, as per the Rugby Football Union (43).

Notably, each football code's specific physical demands are considerably different, likely affecting the pre-season period's length and structure. Components of fitness required for all football codes, regardless of playing position, include aerobic and anaerobic fitness, speed, agility and power (20, 31, 42, 45). However, each code also requires specific physical components to be well developed. Generally, elite soccer athletes require speed, agility, and anaerobic and aerobic fitness due to the dynamic locomotor demands of the game (45). Rugby league and rugby union athletes, due to the generally linear and collisional nature of their code, require a relatively greater level of functional body mass with low body fat percentage, relative and absolute strength and power, as well as aerobic and anaerobic fitness (20). There is a greater emphasis on resistance training to develop such capacities, typically prescribed three to four sessions per week during the pre-season period (39). American football athletes possess divergent physical qualities depending on their positional requirements. For example, skill players (i.e., wide receiver and defensive back) complete more running and locomotor activity, while linemen (i.e., offensive and defensive line) perform higher collisions. Hybrid players (i.e., tight end, running back and linebacker) require a mix of these physical qualities (42, 46, 47). However, due to the intermittent nature of American football and work-to-rest ratios of ~6.2:1 (44), high-performance staff may prioritise anaerobic fitness

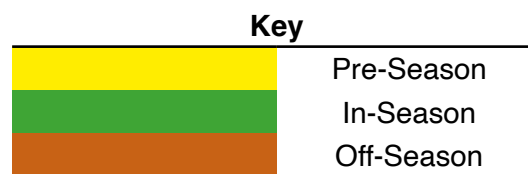
during the pre-season period. Australian rules football athletes generally require a combination of the aforementioned physical traits; aerobic and anaerobic fitness, speed and agility (31). Notably, Australian rules footballers' aerobic and anaerobic capacities are well developed, compared to other football codes (24, 32). Midfielders are frequently running a total distance >13.5km per match (32). Due to the intermittent nature of Australian rules football, a large proportion of these distances are covered at high speeds (> 18 km·h⁻¹) (24, 32).

combined with the contact demands required to condition Australian rules football, rugby league and rugby union athletes, provides a rationale for their extended pre-season periods. However, a 12- to 16-week pre-season may be excessive compared to other football codes. Argus et al. (16) and Bradley et al. (19) suggest that elite football athletes' physical capacities can be developed rapidly in pre-seasons of 4- and 10-weeks. As such, a reduction in the pre-season could be considered for Australian rules football, rugby league and rugby union players to reduce the increased annual calendar workloads currently experienced.

The time required to develop the greater anaerobic/strength demands,

Table 1. Overview of various International professional football leagues' typical annual training and match calendar.

Code	League	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
European Football (Soccer)	EPL (9)	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	Off-Season
	A-League (5)	Pre-Season	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
Rugby Union	G-Prem (4)	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
	Super Rugby (13)	Pre-Season	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
American Football	NFL (7)	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
Rugby League	NRL (15)	Pre-Season	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
	SLE (11)	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season
Australian Football	AFL (2)	Pre-Season	Pre-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season	In-Season



M = month of annual training and match calendar year. F = Finals/Playoffs. EPL = English premier league. A-League = Australian League. G-prem = Gallagher Premiership. NFL = National football league. NRL = National Rugby League. SLE = Super League Europe. AFL = Australian Football League. Data drawn from season fixtures on official websites.

Friendly/Practice/Trial games

Pre-season friendly/practice/trial games are played towards the end of the pre-season (specific preparation) to condition athletes for the competitive season (35). Most professional football teams will participate in between two and five unofficial and/or official friendly/trial/practice games towards the end of their pre-season. Weekly periodisation leading into these practice games, regarding training load and structure, usually reflects what athletes will experience during the competitive season. Squad rotations are high throughout these games, where the predicted starting line-up may only play in the final one or two practice games, allowing developing athletes to showcase their skills leading into the competitive season. The best players are often rested as they play more games during the competitive season. For example, representative athletes competing in the English professional rugby union competition who return late to the pre-season typically train during the early practice games and return to the playing squad for the final practice game in preparation for the start of the season.

Pre-season limitations and restrictions

Interestingly, there are several limitations governing bodies impose on their respective sporting clubs and, therefore, players during the pre-season period. In the AFL, as per the collective bargaining agreement (34), athletes have a mandated three-week rest period during the Christmas and New Year break. As a result, clubs cannot monitor players using wearable technology during these periods. AFL athletes also have a further two 4-day breaks during the pre-season. Notably, in Europe during this holiday period, games are congested, and player workloads increase, likely due to broadcast agreements with people able to watch more football during the Christmas and New Year break. In addition to the Christmas and New Year break, the AFL requires athletes to have two days off during a pre-season week, and if training is on a Saturday, it must be completed by 0930h. The American National Football League (NFL) restricts the amount of contact players can engage with throughout the pre-season. Athletes cannot engage in contact sessions with pads during the first 3-weeks of their pre-season. Further, unique legislation implemented in the NFL is that players can be fined if they do not attend mandatory pre-season training camps. In September 2021, World Rugby, working with the International Rugby Players Association, announced guidelines designed to reduce the amount of

contact training rugby union players undertake (29). The guidelines include a maximum of 15 minutes of unrestricted, high-speed body-to-contact per week, 40 minutes of lower-speed contact using tackle shields and pads, and 30 minutes of intense live training in set-pieces such as lineouts, scrums, and mauls. World Rugby aims to decrease injuries from training and enhance performance by regulating the amount of contact players are exposed to between matches. No inter-player contact restrictions are currently in effect in the NRL or AFL. Likewise, there are no limits on soccer heading practices. Nevertheless, given the developing evidence and legal proceedings relating to head injuries, it is likely that all codes and competitions will consider contact constraints in future.

IN-SEASON PERIOD (COMPETITIVE SEASON)

For this article, the in-season is defined as the period between the first competitive match of the season, and the final complete match (inclusive of finals), or training/recovery session, of the match calendar. The in-season can include the regular season (home and away), external competitions (such as knock-out tournaments), representative/national duties, and finals/play-off matches. It is important to note that training demands differ based on training status and experience, which usually reflects their age during the competitive season. For example, high-performance staff will still look to develop the physical capacities of academy players during this period. The focus is likely on performance and injury risk mitigation for established senior players; however, these details are outside the scope of this article.

Number of games

The length of the in-season period and the number of games varies greatly between professional football codes (Table 1 and 2). Further, the game's duration (in minutes) differs, and associated match demands vary significantly. The present perspective piece suggests that based on each sport's physical requirements, the number of games athletes can safely partake in each year should justify how many games should be scheduled. However, research into the optimal number of games based on workloads and the wellbeing of athletes should consider the extreme circumstances athletes could be exposed to.

Table 2. An overview of each code and leagues' competitive matches played each year.

Code	League	Season Games	Trial/ Pre-season Games	Finals/ Play-Off Games	Rep Games	Minutes/ Game	Gameday Squad Size	# Int	Season squad Size	Salary Cap
Soccer	EPL	38	4-6	-	~18	90	18	3*	25	No cap
	A-League (3)	27	10-12	3	~6	90	16	3*	26	\$2,600,000 AUD
Rugby Union	G-Prem (10)	22	2-3	2	-	80	23	7*	65	£5,000,000 GBP
	Super Rugby (14)	14	2	3	-	80	23	8	35	\$4,800,000 AUD
American Football	NFL (6)	17	4	4	-	60	46	No limit	53	\$224,800,000 USD
Rugby League	NRL (80)	24	2-4	4	3	80	19	8	30	\$9,400,000 AUD
	SLE (12)	29	2-4	2	3	80	19	8	25	£2,100,000 GBP
Australian Football	AFI (1)	22	2-3	4	-	80	23	90	44	\$13,165,950 AUD

*The number of season games, potential maximum number of play-off/finals games, external representative duties (club or international), minutes played during each game, game day squad size, number of interchanges/substitutions (int), and 2021 salary caps in Australian and International elite football leagues. NRL = National Rugby League. SLE = Super League Europe. G-prem = Gallagher Premiership. AFL = Australian Football League. NFL = National football league. A-League = Australian League. EPL = English premier league. *Substituted players may not return to play. Data drawn on salary cap from official organisation announcements.*

In premier European football leagues, athletes compete in 38 home and away games, and other external cup games, and international matches. Additional cup games could include another ~20-25 games in extreme circumstances, should the teams have successful campaigns. In contrast, in the NFL, athletes compete in 17 games during the regular season, plus playoff series. For the main playing squad in the English rugby union (i.e., Gallagher Premiership Rugby), there is potential for athletes to play approximately 35 games. However, due to organisational restrictions, athletes can only play a maximum of 32 games (> 20 minutes), or 30 full game equivalents, with the Rugby Football Union being the only governing body to cap maximum games. The AFL and NRL sit within the middle of these ranges, with 22 and 24 games during their respective home and away seasons, plus a maximum of four finals games. In addition to the regular season matches, it is also common for

professional footballers to play representative/international matches during or after the season. With the addition of representative games and finals in the NRL, some athletes' seasons can be extended to 30- to 32-games, and in extreme circumstances in the EPL, 75+ in one season/year (club and national) (26). As a result, footballers are forced to play in heavily congested periods, which can substantially increase external workload measures, such as Global Positioning System running metrics (23). Despite women being outside the scope of this article, it is interesting to note that recent reports suggest that women European footballers are, in contrast to men, afforded a relatively low number of appearances each season (27). Sampled players averaged ~33 games in 2018/19, resulting in limited growth and development. However, this may be dangerous, as the underload is juxtaposed with heavily congested schedules due to the uneven distribution of matches, and consequently,

straining players and affecting their ability to perform (27). Clearly, in both men's and women's European football, there is a critical need to review and balance the international match calendar to protect players' physical and mental welfare.

Tactical rotations of athletes throughout the year are essential to accommodate the workload placed upon athletes (21). There is an anecdotal consensus in European football that squad depth is crucial to winning the home and away season; however, in the competitions such as the NRL, there is less reliance on squad depth due to the decreased number of games. As such, high-performance staff must structure in-season training and conditioning on the workload demands of individual codes, while accounting for the competition schedule, including representative matches and the duration of the entire season. Despite vast differences in workloads between football codes, the physical and psychological toll of preparing for a game may be detrimental to athlete health (25). The constant pressure to perform, competition for selection, and limited leisure time can take their toll on athletes leading to player burnout (25). As such, these mental aspects, alongside physical workloads, must be considered when discussing the optimal number of games athletes should compete in each year.

Squad sizes

Squad sizes between football codes differ greatly, and large squad sizes are essential for managing workloads by rotating players throughout longer seasons, especially in football codes with excessive external competitions and match congestion (Table 2). However, clubs often have varying restrictions on how many athletes they can sign to their senior team in different codes and competitions. As such, reviewing salary caps and squad sizes may be necessary for managing player workload and wellbeing. For example, professional English rugby union teams can contract up to 65 contracted players, including development/senior academy players. In contrast, clubs only have 45 to 48 players in the AFL, including reserve players who play in their respective state (second tier) competitions. EPL teams usually have fewer athletes in their playing squad and contract 24 to 28 players. In the AFL, if an athlete is injured, they can move onto an injury list (if expected to miss > 8 games), and their position can be filled without impact on the team's salary cap. NFL roster sizes vary depending on the time of the season. NFL teams can retain 68 players on their roster during the regular season, separated

between 53 active roster players (available to play in games) and a 16-man practice squad. Conversely, NFL teams can retain 90 players on their roster during the off-season and pre-season periods.

Days between matches (week-to-week scheduling)

The number of days between matches in professional football varies between codes and can often fluctuate weekly. For example, EPL teams may have as little as two to three days between games when external competitions are scheduled mid-week. These external games could be club games (home and away season and external cup competitions) or national (continental, international or World Cup). Nédélec et al. (41) suggest that in most cases, football players require 48 hours to recover following a game to perform at the same level as pre-match. However, some biological markers, such as creatine kinase (indicative of muscle damage), may be elevated ≥ 72 hours post-match (38). These results suggest that during periods of congested European (soccer) football, athletes likely have not recovered before playing their next game. Similarly, McLean et al. (37) report that measures of acute fatigue (countermovement jump and psychometrics) are reduced 48 hours following a competitive rugby league match and may take up to 4 days to return to baseline. Sport scientists must therefore manipulate training loads based on how many days until the next game, often working backwards in nature (e.g., game day -1, -2, -3, etc.). Bye rounds, where athletes will not play a game, are commonplace in football codes, allow athletes to recover, and may occur during a period of external/representative duties (33). As such, representative athletes often miss the bye round and the opportunity to regenerate and recover. Therefore, it is important that representative athletes are prescribed extended recovery during other components of the annual training and competition calendar.

In-season limitations and restrictions

In European rugby union (Gallagher Premiership), if players compete in a mid-season international game for more than 60 minutes, they must, at some stage, take a week off in the following month (43). However, no other football codes implement restrictions on the amounts of games athletes can play. The Fédération Internationale des Associations de Footballeurs Professionnels (FIFPro) recently called on European football organisations to develop standards and manage player workload to ensure playing careers' longevity and physical and mental performance

health (26). For example, regulatory match caps, reduced long-haul flights, or better management of congested scheduling could be appropriate considerations.

OFF-SEASON PERIOD (ATHLETE RECOVERY)

For this article, the off-season is defined as the period between the match calendar's final competitive match, or training/recovery session, and the first official pre-season training session. The off-season usually comprises a period of complete rest away from the athletes sporting club and structured training completed either at home or club facilities. The off-season is essential for athletes to regenerate physically, mentally, and emotionally (18).

Length and structure

Regardless of the sport, the off-season length highly depends on whether the club qualifies for their respective play-off or finals series. Off-season lengths can be as short as four weeks in European football and as long as five to six months for NFL athletes, depending on whether their team performs in post-season playoffs. Generally, most football codes have an off-season period of approximately six to eight weeks (Table 1). It is common in all codes for the week following the season's final game to involve athletes' medical and physical examinations and exit interviews. In the football codes investigated, a period of complete rest is required, typically due to player associations and bargaining agreements. For example, the AFL collective bargaining agreement states that athletes cannot return before mid-November, ensuring a break of at least ~6-weeks. Similarly, in the NFL, the collective bargaining agreement prevents players from meeting with coaches or training with strength and conditioning staff from the moment their season ends until mid-April, when players are allowed to return for the NFL Off-Season Training program (~2-3 months, depending on the team's advancement in the playoffs). This program continues until the first week of June, ending with a one-week mandatory minicamp before the players are provided with a second period away from the club, lasting until mid-July, the start of the NFL pre-season (~4-5 weeks). In both the AFL and NFL, clubs can provide athletes with off-season conditioning guidelines to encourage training during these idle periods. However, training is not compulsory, and it is against player agreements to enforce upon athletes. Basic off-season conditioning guidelines will usually

incorporate resistance training and cardiovascular conditioning. It is crucial for athletes not to detrain during this period. As short as 4-weeks have been shown to reduce strength and power (39) and may also increase the risk of injury when returning to pre-season training (28). Detraining strategies should be implemented during this period to prevent/modulate reduction in physical activity (22), such as providing guidelines for healthy lifestyles and dietary behaviours to maintain lean mass and avoid increased fat mass.

Off-season limitations and restrictions

In recent years, player associations have been establishing player bargaining agreements that include recommendations for extended off-season lengths and training restrictions during this period. Often, the high-performance team cannot enforce or monitor (with wearable technology) an individual's training program as per player association guidelines (AFL collective bargaining agreement). However, they are expected to complete their training to not return to pre-season deconditioned. Only one of the six off-season training weeks is mandatory in the NFL, where players are fined for not attending. As such, athletes in the NFL are offered financial bonuses for completing conditioning at the club facilities during the off-season period. However, monetary incentives to complete off-season conditioning are likely not viable in all football codes.

CONCLUSION

This piece aimed to provide an overview of the annual training and competition calendar in various international professional football competitions. There is a large discrepancy between football codes in the pre-season period (length and structure), the in-season (number of games), and off-season (time to recover). It appears that the structure is based on the physical workloads of each sport. Nevertheless, there is little research to justify each football code's structure. It is clear that congested scheduling places strain on athletes in multiple codes of football. Reviewing game scheduling, match caps (limiting total games), salary caps and squad sizes may alleviate some of the workload demands placed upon athletes. Future research to identify the ideal number of in-season games, whether physiological or perceptual, could help develop a better framework to support players' physical and mental welfare. Future research could focus on the efficiency of current training practices, with limited

research investigating the specificity of football training. However, due to the individualisation of each football code, this research may not be completed universally. While organisations consider the commercial prospect of elite professional sport, balancing finances with player physical and mental wellbeing is vital to optimising competitions.

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