Loading patterns and programming practices in elite football: insights from 100 elite practitioners

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Periodization | Horizontal Alternation | planning | Physical Work Integration

Headline

In sport, programming physical training contents alongside technical and tactical sequences is supposed to be an easy practice, especially when you have been doing this for a long time. If you're working with Olympic sports and preparing for some annual competition, there are a lot of resources in terms of training programming and periodization (Bompa & Haff, 2019), and much that can be done to develop athletes to reach their maximum potential. In team sports, competing for 6 to 10 months throughout the year however, the current practice and approach in terms of planning is dramatically different and can vary widely from team to team. What about fitting your strength block periodization in between the cup game on Tuesday and the away game next week when you play Commanders FC, the team that is fighting with you at the bottom of the table? When do you program your speed sessions, before or after the extensive air travel over the international break? For the aerobic conditioning phase, do you run it when players return from holidays the week before the season kick-off, or during the Christmas break which could be the only week off you may have (if you are lucky not to compete in the UK!!)? And if this is not complex enough, performance practitioners (i.e., strength and conditioning coaches and sport scientists) also may not be entirely in control of the schedule, design, focus of each cycle, week, day, etc., as the coaching staff may operate in a vacuum or may not want to have a systematic approach to load management and may want to centre the design of each week around a tactical, technical focus. In short, programming workload and, more precisely, the physical content is very complex in team sports.
While there are some informative data now available on programming practices in soccer (Castillo et al., 2019; Chena et al., 2021; Clemente et al., 2019; Hannon et al, 2021; Los Arcos et al., 2017; Malone et al., 2015; Mateus et al., 2021; Martín-García et al., 2018; Nobari et al., 2021; Oliveira et al, 2019), these are generally representative of single club practices and only provide quantitative information (e.g., external load dynamic based on GPS). Unfortunately the reasoning behind the choice and the drivers for content selection are never reported in these descriptive studies. In fact, there is little consensus and very few comprehensive resources available about best programming practices and the elements to be considered when programming the microcycles in team sports (Kyprianou, 2019). We thought that the best way to start filling this gap was to start questioning what people were actually doing in practice. We designed a simple survey to help us uncover the main tendencies within football (soccer), and allow us to derive some programming practices and loading patterns guidelines on a more general level. Having clear objectives, processes and systems to automate the programming of various microcycles (i.e., in relation to match turnovers) is likely beneficial for both staff - less cognitive load and less time needed to program - and players - optimal contents should help to keep them fit, healthy and competitive (Buchheit, 2020).

Aim

The aim of the present manuscript is to provide for the first time the actual loading periodization and session contents programming practices of hundreds of elite practitioners, collected using a large-scale online survey.

Methods

The survey was advertised via emails to the existing company customers and on social media in May 2021. The survey was made available in both English and Spanish and consisted of 39 questions, including questions on the demographics, overall loading periodization practices and session contents programming. Importantly we also asked questions about the drivers and elements considered to make those programming decisions.

Data Analysis

Descriptive data are presented as percentages of the total number of responders - since multiple responses were often allowed for a given question, the percentages rarely sum up to exactly 100%.

Results

Demographics

Overall, we received 145 responses - however, for the current manuscript, only responses related to professional football clubs were analyzed (e.g., national teams or academy data were excluded, and only 1st or 2nd league data were used, n = 100). Each performance practionner's position and role was first reclassified using the model suggested by Buchheit and Carolan (Buchheit & Carolan, 2019). They were in fact occupying positions of Head of Performance (55%), Strength & Conditioning (30%) or Sport Scientists (15%), and were working in all top leagues in Europe, the USA, South America and Asia. All prestigious and top-level leagues were represented with more than 40% of the respondents working in either the English Premier League, La Liga, Ligue 1, Serie A or the Bundesliga. The completion time was 15 min. on average.

Responses

Because of the variability in responders' profiles and approaches, it was difficult to run sub-group analysis; therefore, all 100 responses were analyzed together.
The responses were grouped and summarized according to the following categories:

- Periodization approaches and practices
- Integration between physical and tactical work

- Loading dynamics
- Programming session contents at the team level
- Programming the individual work
  - Substitute compensation
  - Individual supplementation

Periodization approaches and practices

Figure 1 shows the different Periodization and programming models used by the respondents. Whether they followed a specific (e.g., Delgado-Bordonau & Mendez-Villanueva 2012, Raymond Verheijen & Hiddink G. 2014, Tarrago et al. 2019) or custom paradigm, a very large majority reported alternating overall session load and both physical and technical contents between each training day. This focus on daily load and contents alternation follows what is called "horizontal alternation" and has roots in the tactical periodization model (Delgado & Mendez-Villanueva, 2012). There are multiple rationales for this practice. One in particular centres on the fact that in the very complex context of team sports such as football, the only way to manage players' health, fitness and competitiveness every weekend is to constantly chase opportunities to work, and this can only happen and be beneficial when players are recovered and ready to train. In this sense, the interchange of load and contents from one day to another within the microcycle allows for repeated short periods of work and recovery in an almost continuous (season-based) scale. As a matter of fact, performance coaches were reported to have the greatest influence on those loading and programming patterns (Table 1) - with likely sport science and medical supporting the process, and coaches validating the final sessions (Buchheit & Carolan, 2019).

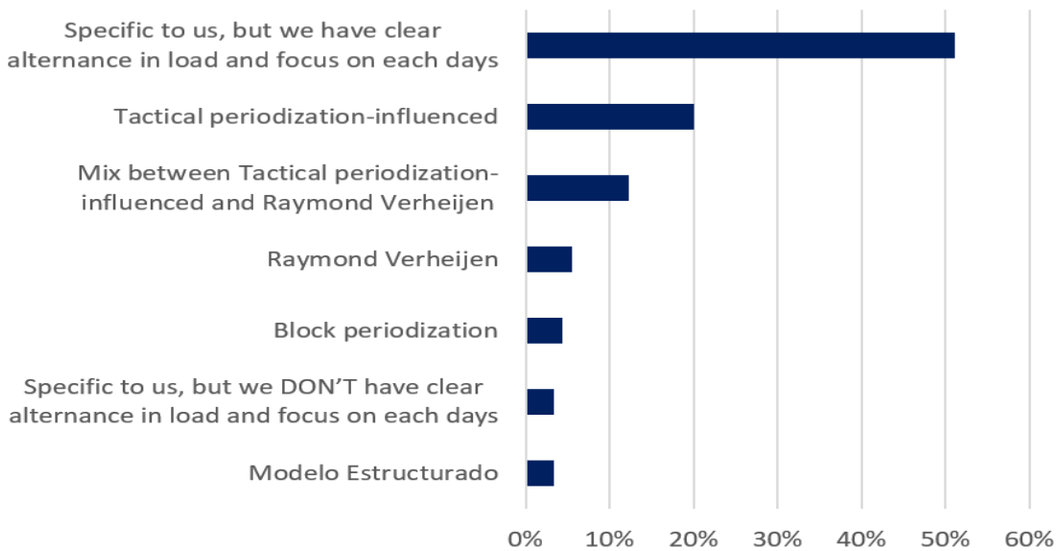

Fig. 1. Periodization and programming models used

Table 1. Who is making decisions on sessions, physical loading and content?

	Technical Staff	Performance Coaches	Medical Staff	Sport Science
Not part of the decision	3%	0%	16%	6%
Consulted only	9%	0%	47%	6%
Some kind of influence	27%	10%	26%	38%
Large input	27%	39%	8%	31%
Very large input	34%	51%	4%	18%

Integration between physical and tactical and technical work

Physical work was reported to be well integrated with the tactical and technical work (Figure 2). Approximately 50% of respondents were actually programming technical work in relation to the physical requirements of the day, and vice versa (Delgado-Bordonau & Mendez-Villanueva 2012). The way this integration was achieved was highly variable and likely context-driven (even within the same club), since all three possible approaches were reported to be used with a high frequency. The associated approach was the most frequently cited though, followed by the integrated and then the dissociated method (Table 2).

Programming session contents at the team level

The different factors to be considered when planning sessions are summarized in Tables 3-8. When it comes to selecting session contents, there was some strong agreement among practitioners and, not surprisingly, the place of the session within the microcycle in relation to turnover length was rated as by far the most important variable to consider (Table 3). This is consistent with the idea that in season, when the emphasis is on competing, teams need first to recover from / compensate for the matches, which determines the first 48h post match contents. Thereafter, and only when the turnover length permits (Table 9), they tend to program a few development sessions (over 1 to 2 days for 6- to 7-d turnovers) - before tapering again and getting ready for the next match (24-48h pre match). The reality is that there is little room for proper physical development and loading content which are generally placed mid week (see "Team loading dynamics" section). The consequence of this is that there is likely some specific content that fits better on some days than others such as recovery or day off at D+1 (or D+2), large volume and high-speed running on D-3 and agility/activation at D-1, respectively. This is discussed later in the manuscript as well ("Training content programming at the team level" section). Interestingly, most of the other elements used to decide on training contents were all rated as important, from the tactical orientations of specific days, to the use of load monitoring data to adjust load.

The overall load dynamic at the mesocycle/macro level (time in the season, international breaks, zero-match week...) was also deemed to be an important driver of session content. Current results and present number of injured players seemed to affect fewer practitioners' choices (not considering much current injury occurrence was however an unexpected result for the authors) (Table 4). The changes in training content in relation to these latter factors were mainly reflected at the individual level (Table 5).

There are also many ways to skin a cat when programming within-session content (Table 6). The greatest level of agreement was reached for the intended volume of work and the achievement of specific physical targets (likely km run, distance of high speed running covered, etc.). As always, the technical/tactical orientation of the session was also reported to be important in driving the main part of the physical load. In this case, performance practitioners need to program their physical load around the technical/tactical aspects (Table 2) to both adjust the overall load and preserve/reinforce the physical focus of the day (Buchheit, 2019).

When preparing their sessions, performance practitioners reported to rely a lot on both their overall knowledge about human physiology and experience. Following a framework (i.e., power day comes after max strength day) and having clear objectives were also reported to be important, and more important than using examples of exercises or drills found in the literature.

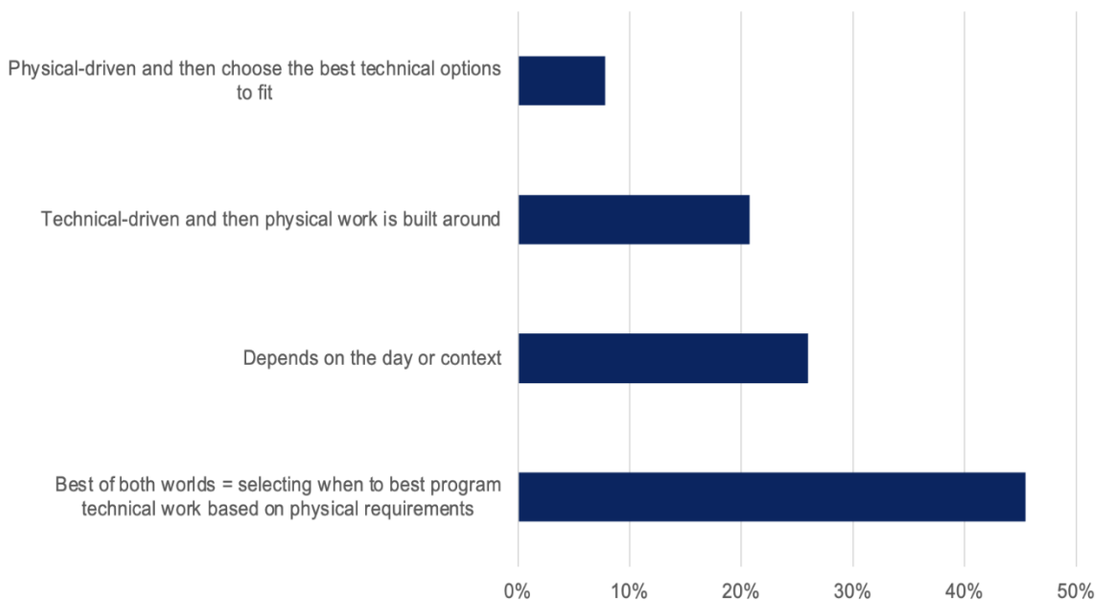

Fig. 2. **Drivers for daily training loads and session contents**

Table 2. What approach do you use to combine physical and tactical work?

	Dissociated	Associated	Integrated
Less preferred	22%	13%	14%
Prefered, but it depends on context first	44%	56%	52%
Majority of contents	34%	31%	34%

Dissociated: mind your own business. Strength coach in the gym, conditioning coach on the track and technical staff to coach football, not sure there is always a link between both worlds on that day though.
Associated: Strength and conditioning coach to work in the gym or on the pitch immediately before and after the session with a variable alignment between this latter work and the physical orientation of the tactical parts.
Integrated: with the ball, better if partners and opponents, best example is the use of small-sided games.

Table 3. Elements taken into account when programming overall sessions load and contents for a given day.

	Doesn't matter	Not Very important	Depends	Important	Very important
Place in the microcycle / distance from and to matches	0%	0%	3%	19%	78%
Tactical orientations to prepare matches	0%	4%	19%	47%	30%
Physiology principles	1%	4%	16%	56%	23%
Experience/knowledge	0%	3%	10%	57%	30%
Data feedback: adjust for the load of previous days	0%	0%	21%	57%	22%
Data feedback: adjust for players responses to previous days	0%	3%	29%	44%	25%

Table 4. Additional contextual factors that can drive overall loading patterns.

	Doesn't apply to my context	Doesn't matter	Not Very important	Depends	Important	Very important
Time in the season	0%	1%	1%	17%	48%	32%
Importance of upcoming matches	0%	1%	19%	17%	42%	21%
Recent results	0%	12%	23%	35%	22%	8%
Returning from International periods	6%	1%	4%	27%	45%	16%
Zero-match weeks	3%	5%	4%	21%	45%	22%
Number of players injured at the moment	0%	5%	17%	29%	25%	25%

Table 5. Main adjustments to the different elements considered in Table 3 and 4.

Overall loading patterns for the team	55%
Overall loading patterns for some individuals only	81%
Working on specific physiological capacities (different than usual)	34%

Table 6. Elements taken into account when programming the physical work within sessions.

	Doesn't matter	Not Very important	Depends	Important	Very important
Technic/tactics only and the rest follows	1%	13%	52%	29%	5%
Training circumstance (e.g., number of players available)	5%	14%	27%	39%	14%
Intended duration of the session	5%	13%	30%	38%	14%
Intended volume of work of the session	0%	3%	10%	60%	27%
Intended session intensity	0%	4%	8%	40%	48%
Intended intensity of some sequences	0%	6%	16%	43%	35%
Hitting specific physical targets	3%	0%	17%	30%	51%

Table 7. Elements taken into account or used when preparing field/pitch/court work, for a given day.

		Doesn't matter	Not Very important	Depends	Important	Very important
Field/Pitch/Court work	Own experience of similar field sessions	0%	0%	9%	56%	35%
	Examples found in the literature	4%	35%	38%	21%	3%
	Follow general physiology principles	0%	5%	14%	61%	19%
	Having specific objectives (reaching a specific % of match load)	0%	6%	10%	48%	35%
	Following a framework (i.e., positional work with ball comes after generic training)	1%	10%	35%	43%	10%

Table 8. Elements taken into account or used when preparing gym work, for a given day.

		Doesn't matter	Not Very important	Depends	Important	Very important
Gym work	Own experience of similar gym sessions	0%	3%	12%	47%	39%
	Following a framework (i.e., power day comes after max strength day)	1%	1%	25%	40%	32%
	Muscle physiology (e.g., number of reps/sets in the gym)	0%	0%	5%	53%	42%
	Examples found in the literature	4%	23%	43%	21%	9%

Table 9. Preferences for overall load periodization in relation to match turnovers.

	Days from last Match	Team day off	High overall load	Moderate overall load	Low overall load
7-d Turnaround	D+1/D-6	32%	0%	6%	48%
	D+2/D-5	62%	4%	23%	26%
	D+3/D-4	3%	70%	29%	0%
	D+4/D-3	14%	71%	12%	3%
	D+5/D-2	1%	1%	48%	31%
	D+6/D-1	1%	0%	18%	64%
6-d Turnaround	D+1/D-5	26%	0%	3%	34%
	D+2/D-4	35%	9%	23%	14%
	D+3/D-3	4%	55%	17%	0%
	D+4/D-2	1%	3%	42%	21%
	D+5/D-1	0%	0%	13%	52%
5-d Turnaround	D+1/D-4	13%	0%	3%	34%
	D+2/D-3	21%	8%	21%	19%
	D+3/D-2	1%	5%	52%	10%
	D+4/D-1	0%	0%	12%	47%
4d Turnaround	D+1/D-3	16%	0%	1%	39%
	D+2/D-2	5%	0%	27%	39%
	D+3/D-1	0%	0%	14%	53%
3-d Turnaround	D+1/D-2	3%	0%	17%	47%
	D+2/D-1	0%	0%	8%	61%

Team loading dynamics

Analysis of the overall weekly dynamics (Table 9 and Figure 3) revealed large agreement around programming high loads mid-week (i.e., the 'acquisition days' within the tactical periodization approach, Delgado-Bordonau & Mendez-Villanueva 2012), with these high loads disappearing progressively as the turnover length decreases. For a 7-d turnover, practitioners reported the programming of 2 days with high loads (D-4 and D-3), one day for a 6-d turnover (D-3) while no high loads were reported for the shorter turnovers. The data suggests that at least 5 days between matches may be needed to be able to program high loads during the training week. This leaves 2 days to recover from the previous match before these 1 or 2 days of high load days, and then 2 more to recover from this intense work and prepare for the next match.

This switching of high loads every 3 or 4 days in training, separated by exclusively moderate to low loads, is equivalent to the scenario that happens during congested fixtures (3 and 4-d turnovers, Table 9), when high training loads are added to the high loads of the matches. Interestingly, it is also worth noting that a large proportion (45%) of practitioners reported not to program any high load day within a 6-d microcycle (Table 9), as if the 'loss' of a single day to train was already compromising their ability to program even a single and typical 'acquisition' day.

Despite the large agreement in terms of overall load dynamic (Figure 9), there remained some slight variations for each day, and particularly at D-2 and D-1. A deeper analysis of this specific 2-day sequence (Table 10) revealed that while a moderate load was preferentially prescribed at D-2 during a 7- to 5-day turnover, a light load tended to be prescribed for 3- and 4-d turnovers. This is likely related to the fact that during the shorter turnovers, emphasis is put on recovery, and that in this context, even moderate loads may be contraindicated at D-2.

The other interesting finding is the very highly consistent alternating of load between D-2 and D-1. For instance, for all sessions programmed with a moderate load on D-2, a low load was almost always programmed at D-1, irrespective of the turnover length. Conversely, when a low load was programmed at D-2, a moderate load was very often planned at D-1. This first confirms the belief that load may need to be alternated from one day to the next as reported in Figure 1. This also suggests that practitioners think that (1) having two consecutive moderate sessions would likely be too much to recover from either the previous match (3- to 5-d turnovers) or any hard training session (6- to 7-d turnovers), (2) two consecutive light sessions may not be enough to prepare players to compete (intensity of specific match preparation drills).

It is worth noting however that while the loading dynamic discussed until now is meant to reflect the overall team dynamic, in reality this dynamic may only concern the 11 starters at most. In fact, while these starters tend to perform a low load recovery session on D+1 (as per Table 9 dynamic), all benched players and substitutes generally train hard to compensate for the match they didn't play (Table 11). This "recovery period" for starters generally takes place over 2 days, with D+2 being either a day off (especially for 7-day turnovers, Table 11) or a light load for them (with their load being 'reduced' from that of the benched/subs) if training is programmed.

Another key element for both the quality and effectiveness of starters' recovery and the effectiveness of benched and substitute players is the programming of the D+1 session (i.e., contents of course but also timing). For starters, it's about doing all that is possible to accelerate their recovery and often check/treat some minor injuries or niggles. For benched and substitute players, it's about keeping the rhythm and maintaining their competitiveness.

While the timing of sessions is a subject that is often highly debated among staff (and even among players!), it's a topic that has received almost no attention in the scientific literature - probably due to the fact that it's very difficult to assess the effect/impact of programming an AM vs. a PM session. Staff tend to use common sense, and often try to find the best compromise between physiological, logistical and sociological considerations (Buchheit, 2017). Training too early aftar a match day may compromise sleep, which can affect starters' recovery (since sleep is probably the best recovery strategy of all -Vitale et al., 2019-) and substitutes' readiness to train (who need to train hard to compensate). Training in the morning is almost the norm in elite football, since (1) it allows for a greater control of sleep (condition sleep to be aligned with family and daylight) and nutrition (breakfast and lunch generally taken at the club), and (2) leaves room for players' social lives in the afternoons/evenings.

Following home matches (Figure 4) about half of the practitioners reported that they still train in the morning the next day irrespective of the match's timing, next match location, result or turnover. Another 15% also reported having a preference for morning sessions, but admitted that this could be changed based on the timing of the next match. This suggests that practitioners may consider sleep opportunities to be sufficient after home matches.

Following away games (Figure 5), there was real no consensus with almost all options possible, from morning to afternoon or midday, with adaptable vs. fixed scheduling. The tendency was that practitioners had to be more adaptable to allow, and even create, this sleeping opportunity. Training may optimally be programmed mid-day and the timing to be directly depending on the time the team would come back, and when the next match would be programmed. Common practices also include having a day off at D+1. This solves the programming question but reduces opportunities to care for starters and compensate for benched and substitute players (see above). The question of what day to take off (Figure 3), and even whether to give a day off at all (while it was clear that either D+1 or D+2 is given off for 7-d turnovers, there seems to be less of a need for a day off for 6-d and shorter turnovers), is also something that has not been examined scientifically despite the immense importance of it in terms of recovery, compensation and psycho-social team dynamic (Buchheit 2017).

Training content programming at the team level

The programming of some specific training contents on specific days (Table 12 and Figure 6) refers again, as discussed earlier (Figures 1 and 3 and Tables 9 and 10), to the so-called horizontal alternation rooted in the tactical periodization model (Delgado-Bordonau & Mendez-Villanueva, 2012). In fact, in the highly complex context of football, the only way to trigger specific physiological adaptations is likely to overload a single physical capacity over a given day rather than over a typical micro or meso cycle as done in many other sports (especially individual sports). The idea behind this horizontal periodization is that while the targeted physical quality of the day may be overloaded, the other qualities would be relatively underloaded, and should then be able to recover. In theory this should allow practitioners to work on all those physical capacities throughout the week without creating overload on any one, or excessive fatigue and increased injury risk. This organisation also allows to 'touch' and train each important

physical capacity over the microcycle (at least for 6- and 7-d turnovers), which should help to maintain players' health and fitness throughout the entire season. For that reason, practitioners tend to 'put all their same eggs in one same basket a day', aligning at best the physical orientations of drills on the pitch to those performed in the gym both before and after training (if any). When the acute responses to such specific conditioned-sessions were examined in elite players (Buchheit et al., 2018), pre to post changes in neuromuscular status were shown to be very specific to each context. For instance, while strength-oriented sessions (small-sided games over reduced spaces and complementary locomotor strength work on the pitch) were associated with increased measures of propulsion efficiently, this same index was indicative of acute posterior chain fatigue following high-speed drills and games over large spaces. This data then confirmed the fact that manipulating drills and content may result in specific neuromuscular responses which may, in turn, drive specific physiological adaptations for each day of the microcycle (Delgado-Bordonau & Mendez-Villanueva, 2012).

While this model may function irrespective of the approach with which physical and technical components are integrated (Table 2), the ideal models in this context are likely to adopt a combination of integrated and associated contents (Table 2).

The question of what is the most appropriate content for a given day is probably the one that receives the most interest from practitioners. In contrast, there is a scarcity of research on the topic, and hence little evidence to guide practices. Additionally, in comparison with 2- or 3-d turnovers when the schedule is almost set in stone (i.e., "recover and get ready to play again!"), there are so many contents that can be programmed, and load to be optimized during long turnovers, that it is in fact much more important to have things right in this latter context. The programming of 5- to 7-d turnovers is therefore likely to be one that requires the greatest level of care and preparation (Buchheit 2020). For some content there was clear agreement among respondents such as for the programming of strength work both in the gym and on the pitch (D+3/D-4), high-speed running (D+4/D-3) and unplanned agility work (D+6/D-1) during 7-d turnovers. For other turnovers, and/or contents, the practices looked highly variable - suggesting that there are definitely many ways to skin a cat (choosing 1 day over another), but also that some contents may also be able to be programmed on different days. This latter option was definitely the case for some contents such as mobility and flexibility exercises, for which practitioners reported them to be programmed almost equally all days of the microcycle.

Mobility and flexibility exercises can likely be programmed every day of the microcycle since they don't add up to the (neuromuscular) load of the day, and may even help to "digest" the work done in parallel. For example, the fact that mobility and flexibility is programmed with a greater consistency on D-2, irrespective of the turnover length (Table 12) is consistent with the need to recover from the intense previous couple of days (e.g., a match or the strength and endurance days), which often leave players sore and stiff (Silva et al, 2018). In contrast, because some specific contents (e.g., eccentric-biased prevention work, high-speed running) may create muscle soreness and acute (neuromuscular) fatigue, it's not surprising to see them programmed at least 3-4 days from the next match, but also to see them progressively disappearing as turnover duration decreases (Table 12 and Figure 6). Following the discussion on overall loading patterns above, the recovery from these 'aggressive' contents needs to be possible before the next match to allow their programming within the current microcycle.

Another important observation is how contents are reorganized when transitioning from a 7- to a 6-d turnover (Figure 6): since there is one less 'acquisition day', practitioners have to redistribute the contents usually programmed over 3 days into 2 days. This is often achieved while keeping the 'speed' day unchanged at D-2, but merging the 'strength' and 'endurance' days together on D+3/-3 (i.e., 'mixed' content day). However, since the 3 sessions volumes can't obviously be summed over 2 days, the overall volume of work needs to be reduced. Interestingly, this seems to occur via a greater reduction in strength vs. High-Speed Running (HSR) work (both gym and pitch works are largely reduced, but there is an even greater reduction in gym work). The preference for HSR over strength work can be related to the fact that (1) in contrast to typical strength work, HSR often includes a metabolic component that is necessary to be kept during the microcycle (at least if performed in the form of High Intensity (HIIT), with short recovery period - and not tempo runs - Buchheit, Vassalo and Waldron, 2021), and (2) HSR is likely perceived as more specific in relation to the neuromuscular and locomotor demands (and when there is something to drop, people likely prefer to keep specific over generic contents in relation to short-term performance and injury prevention). Finally the occurrence of HSR on this D+3/-3 session is also very likely promoted by the types of drills programmed: while coaches generally need to program drills over large spaces for tactical purposes at least once during the week, those playing sequences are the only ones that allow players to reach high running speeds (Hill-Haas et al. 2011).

At last, it is also worth noting that since a large proportion (45%) of practitioners reported not to program any day with high load within a 6-d microcycle (Table 9), the redistribution of contents discussed above in relation to a 7-d turnover may be even greater, with both strength and HSR stimuli being minimized - the performance and health consequences of avoiding high loads during a 6-d turnover are behind the scope of the present manuscript and are difficult to predict, but in the authors' view point, may be suboptimal given the fact that there remain at least one opportunity to work hard (i.e., D+3/-3 session) - and may lead to deconditioning.

Finally, while there is some rationale to program some specific contents on specific days (i.e., reactive unplanned agility at D-1 as a way to prepare players for the match), the sequence order of some other contents is still debated among practitioners. This is likely due to the lack of robust evidence. An interesting example of this latter point is the programming of maximal sprinting speed (MSS) work, which is reported to happen on various days (e.g., D-3 and D-2 at the team level, Table 12 and Figure 6) of the longest microcycles. In accordance with the discussion around the alternance of moderate vs. light loads between D-2 and D-1, the sequence order of HSR and MSS work may have some relevance in the context of injury risk. In fact, since high training loads including HSR and playing over large spaces (which are mainly programmed on D-3) likely induce acute posterior chain fatigue (Buchheit et al., 2018), the programming of MSS work the next day (D-2) could expose players to a higher risk of injury during those sprints (assuming that increased neuromuscular fatigue and the changes in mobility/pelvic control that follow such sessions increase injury risk) (Verrall et al., 2001, Watson et al., 1995, 2001). For that reason probably, and in somewhat contradiction with the orientation of the tactical periodization approach that advises to plan speed work on D-2 (Delgado-Bordonau & Méndez-Villanueva, 2012), 75% of practitioners reported to program MSS on the same day as

HSR (D-3) for both 6- and 7-day turnovers (Figure 7). This is often achieved during game-play sequences over large spaces, and/or through specific speed top-ups post session when targets (>90% of maximal sprinting speed) are not reached during the tactical drills. Albeit anecdotal, several practitioners commented in their notes that while they had started to program MSS work at D-2 in the line of the tactical periodization paradigm, they ended up changing this specific programming aspect for the above-mentioned reasons (Kyprianou, 2020). Another important comment in relation to this specific point, is that having 'speed' as the focus of the third acquisition day (following 'strength' and 'endurance', Delgado-Bordonau & Mendez-Villanueva 2012) may have been sometimes misunderstood: 'speed', as originally introduced, may not necessarily involve MSS work, but likely simply refers to speed of execution, which is often implemented via short attacking transition work and finishing actions without the need to reach >90% of MSS.

Programming individual work - Substitute compensation

The optimal strategy to compensate for benched and substitutes players seems to be to spread the load over a few days, with the preference for both immediately after the match and at D+1 (Table 13). The possibility to keep compensating at D+2 was also frequently cited (when D+2 is not a day off, Table 11). However, because training immediately after the match can be challenging (lack of time when away, benched players reluctant to do it and hiding in the shower, etc.), many practitioners also organize the compensation on D+1 and D+2 exclusively.

Interestingly, the need for a compensation session for benched/substitute players decreased as the turnover length decreased (Table 11). This is likely related to the fact that for short turnovers the load associated with successive matches is believed to be sufficient to maintain players' fitness, and that 'missing' one opportunity to be loaded (via match or its compensation) may be seen as an opportunity to let players recover. Also, for short turnovers it is challenging to compensate well while still allowing players to recover on time for the next match (since 2 days are likely needed, Table 9). Consistent with the above, the two most important factors taken into account when programming the compensation sessions were match minutes played and the distance from and to the next match (Table 14). The lower the playing minutes and the longer the turnover, the greater the need for compensation. Individual player preference was frequently cited, suggesting again the need to individualize this strategy (both at the content and timing -D0 vs. D+1- levels).

Finally, most of the suggested benchmarks were rated with the same level of importance (Table 15), and included reaching certain locomotor and physiological targets, often based on match demands (accumulating a given proportion of usual match running performance) and physiology (e.g., reaching 90% of maximal sprinting speed or accumulating a minimum of time >90% maximal heart rate). While keeping a technical element seemed important, the importance of having fun was not consistent. For the reasons mentioned above, those sessions generally include a combination of small-sided games, position-based finishing work (which can include more or less metabolic conditioning and speed, depending on the context) and complementary individual gym work (Lacome et al. 2018; Buchheit, 2019; Laursen & Buchheit, 2018).

Table 10. Load dynamic two and one day before competition as a function of turnover length.

Matchs Turnover	D-2 LOAD		D-1 LOAD	
7-d	Moderate	60%	Moderate	3%
			Low	97%
	Low	40%	Moderate	48%
			Low	52%
6-d	Moderate	65%	Moderate	17%
			Low	84%
	Low	35%	Moderate	83%
			Low	17%
5-d	Moderate	84%	Moderate	16%
			Low	84%
	Low	16%	Moderate	71%
			Low	29%
4-d	Moderate	43%	Moderate	10%
			Low	90%
	Low	57%	Moderate	88%
			Low	12%
3-d	Moderate	27%	Moderate	15%
			Low	85%
	Low	73%	Moderate	83%
			Low	17%

The suggested loading patterns reflect the greatest percentage of responders' preferences on each day.

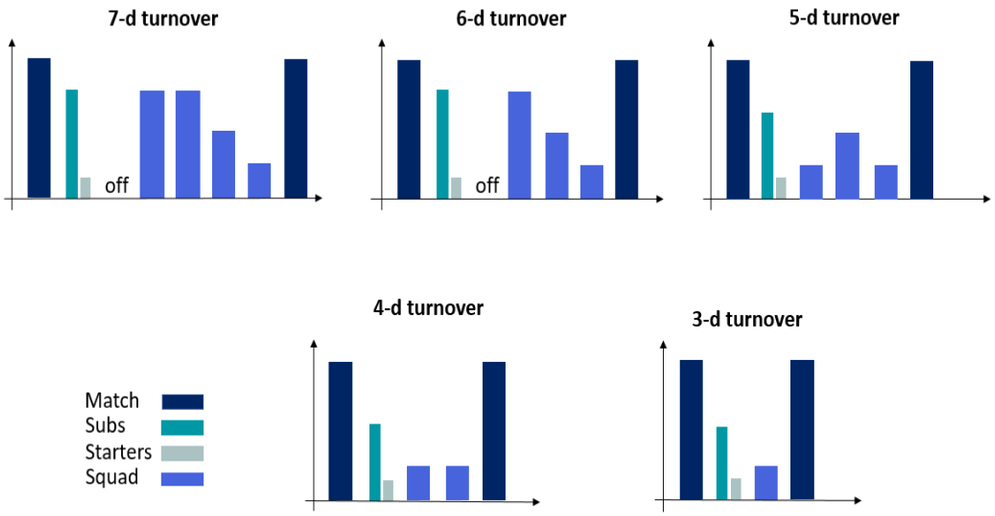

Fig. 3. Typical load periodization in relation to match turnovers.

Table 11. Programming of recovery and compensation days in relation to match turnover length.

	Days from last Match	Starters recovery day	Sub compensation
7-d Turnover	D+1/D-6	74%	62%
	D+2/D-5	29%	22%
	D+3/D-4	0%	5%
	D+4/D-3	1%	3%
	D+5/D-2	3%	3%
	D+6/D-1	0%	1%
6-d Turnover	D+1/D-5	78%	55%
	D+2/D-4	22%	16%
	D+3/D-3	0%	4%
	D+4/D-2	0%	0%
	D+5/D-1	0%	4%
5-d Turnover	D+1/D-4	73%	47%
	D+2/D-3	26%	16%
	D+3/D-2	1%	1%
	D+4/D-1	0%	1%
4d Turnover%	D+1/D-3	75%	45%
	D+2/D-2	25%	19%
	D+3/D-1	0%	1%
3-d Turnover	D+1/D-2	94%	32%
	D+2/D-1	6%	3%

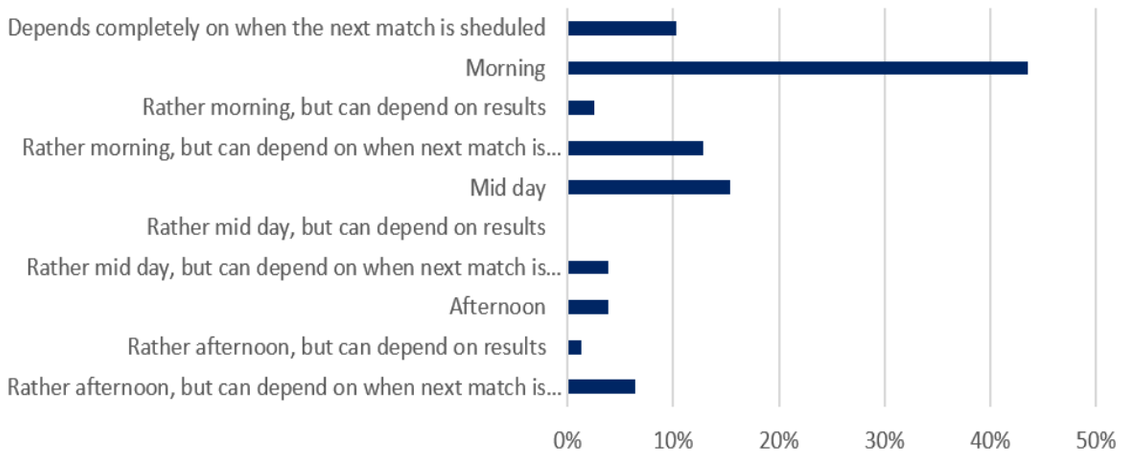

Fig. 4. **Programming of the D+1 session following an evening home match.**

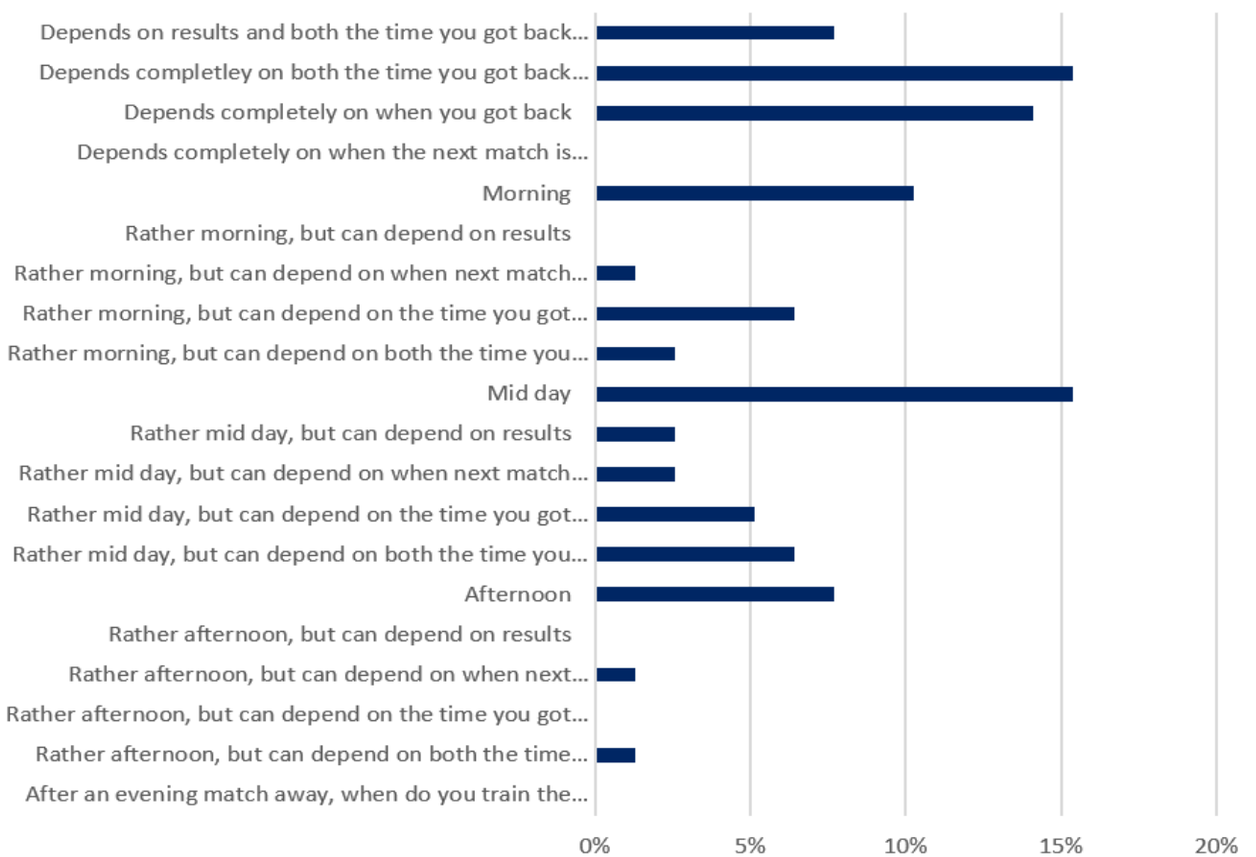

Fig. 5. **Programming of the D+1 session following an evening away match.**

Programming individual work - Individual supplementation

The view around the programming of individual supplementation (Table 16) received less consensus than that of benched and substitutes players, probably for the fact that (1) there are so many variables that need to be supplemented, that the timing of their programming can't always be consistent, and (2) there are always many ways to skin a cat even when it comes to training a given physiological capacity (e.g., high-intensity vs. submaximal running or integrated small-sided games vs. generic/dissociated runs to improve aerobic function, Laursen & Buchheit, 2018).

The strategy that seemed the most practical for this was to spread this load and content over 2-3 days, likely mid-week. Following minutes played and distance from and to previous/next match that determine players' loading capacity and priority (as per the subs, Table 14), individual player profile (including age, position and preferences) was reported to be the most important driver to those sessions (Table 17). While beyond the scope of the present manuscript, this individual profiling is generally made of a mix of different information based on both objective (e.g., testing data to draw strength and weaknesses, typical match demands) and subjective information (e.g., player preferences, technical and tactical requirements for the matches, etc.). As per the substitutes, most of the suggested benchmarks were rated with the same level of importance, and included reaching certain locomotor and physiological targets, often based on match demands and physiology (Table 18) (Lacome et al. 2018; Buchheit, 2019; Laursen & Buchheit, 2018).

Overall the orientation of the different contents was similar between compensation and supplementary work (Figure 8), with combined locomotor/metabolic + strength + technical components (which integrates all the physical components of the activity) being prefered over only metabolic + technical work, only metabolic + strength and metabolic only, respectively. However, there seemed to be a greater need for technical integration for substitutes (with or without additional strength work). This is consistent with the fact that the objectives of the compensatory work are not only physical, but should also help players to practice and maintain their technical skills.

Also, the more even distribution between the different types of approach for player supplementation is consistent with a more tailored training programming, where training is generally aimed at developing some specific and clearly prioritized physical or technical capacities.

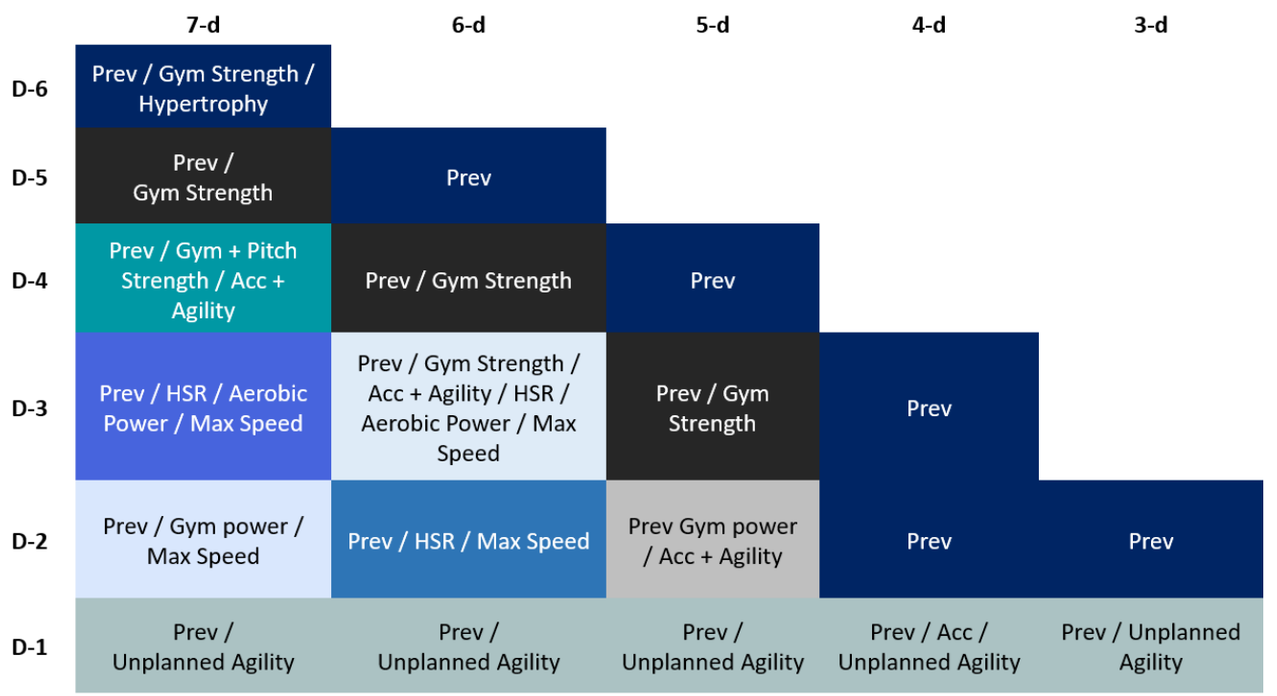

Fig. 6. **Programming of the main training contents in relation to match turnovers. HSR = High-Speed Running**

Table 12. Programming preferences of selected training contents in relation to match turnovers

	Days from last Match	Gym strength	Gym power	Gym hypertrophy	Pitch strength	Pitch power	Aerobic power	Endurance	High-speed running	Max speed	Resisted speed	Speed repeats	Acceleration	Agility (COD)	Unplanned agility and reaction	Prevention (structural)	Prevention (mobility, control, etc.)
7-d Turnover	D+1	23%	5%	21%	3%	3%	5%	10%	13%	4%	3%	6%	1%	1%	0%	36%	40%
	D+2	25%	9%	16%	8%	5%	12%	17%	6%	3%	4%	5%	8%	9%	8%	30%	35%
	D+3	73%	45%	26%	48%	29%	30%	23%	30%	19%	34%	30%	58%	55%	19%	65%	51%
	D+4	23%	31%	12%	13%	26%	42%	39%	64%	55%	22%	29%	27%	29%	14%	49%	45%
	D+5	19%	26%	8%	4%	16%	1%	3%	18%	25%	3%	9%	16%	25%	14%	43%	51%
	D+6	1%	13%	1%	1%	10%	1%	1%	4%	6%	1%	4%	23%	25%	38%	18%	29%
6-d Turnover	D+1	16%	4%	14%	4%	3%	4%	4%	4%	3%	0%	4%	3%	3%	0%	26%	32%
	D+2	30%	13%	16%	16%	4%	5%	14%	10%	5%	3%	6%	14%	14%	4%	29%	30%
	D+3	39%	31%	13%	27%	27%	43%	36%	52%	44%	26%	25%	36%	31%	13%	43%	32%
	D+4	8%	14%	9%	3%	8%	1%	3%	18%	19%	4%	3%	14%	13%	13%	23%	42%
	D+5	0%	4%	0%	0%	5%	0%	0%	0%	4%	0%	1%	19%	18%	30%	10%	25%
5-d Turnover	D+1	16%	4%	14%	3%	0%	5%	5%	8%	3%	3%	3%	5%	4%	1%	27%	31%
	D+2	21%	6%	6%	8%	0%	8%	9%	14%	8%	3%	4%	9%	10%	4%	31%	19%
	D+3	12%	14%	6%	5%	0%	5%	5%	18%	16%	4%	10%	21%	21%	14%	27%	34%
	D+4	0%	4%	0%	0%	0%	1%	0%	0%	4%	0%	0%	14%	9%	22%	10%	18%
4d Turnover %	D+1	17%	9%	8%	8%	6%	6%	6%	12%	8%	3%	5%	8%	8%	1%	26%	26%
	D+2	6%	10%	3%	3%	6%	4%	8%	8%	1%	3%	5%	10%	13%	10%	30%	44%
	D+3	0%	4%	0%	0%	6%	3%	0%	4%	6%	0%	3%	19%	17%	26%	14%	23%
3-d Turnover	D+1	6%	6%	1%	3%	1%	4%	5%	4%	3%	1%	1%	6%	5%	5%	19%	42%
	D+2	0%	0%	0%	0%	1%	0%	0%	0%	1%	0%	1%	10%	14%	18%	16%	31%

The suggested training contents reflect the greatest percentage of responders' preferences on each day.

Fig. 7. Timing (D-3 vs D-2) of max speed work programming when high-speed running is programmed on D-3.

Table 13. Substitutes compensation: when?

	1st choice	2nd	3rd	4th	5th
Post match D0 only	20%	32%	11%	13%	1%
D0 and D+1	47%	24%	3%	2%	1%
D+1 and 2	13%	18%	41%	5%	0%
D0, +1 and +2	9%	7%	18%	41%	2%
Not needed	5%	0%	3%	5%	64%

Table 14. Substitutes compensation: factors to be considered

	Doesn't matter	Not Very important	Depends	Important	Very important
Minutes played	0%	1%	1%	20%	55%
When was the last full match played	0%	5%	11%	39%	22%
Distance from next match	1%	1%	8%	42%	25%
Playing position	6%	23%	25%	17%	6%
Individual profile (physical)	2%	5%	26%	28%	16%
Individual preference	8%	19%	36%	10%	4%
Others	34%	9%	28%	3%	3%

Table 15. Substitutes compensation: what are the benchmarks?

	Doesn't matter	Not Very important	Depends	Important	Very important
Reaching certain thresholds in terms of external load (e.g., % of max speed, distance accumulated)	1%	2%	4%	37%	33%
% Match demands targets	0%	4%	14%	32%	27%
Reaching certain thresholds in terms of internal load (e.g., % of time spent in HR zones)	2%	17%	20%	30%	8%
Based on physiology (e.g., number of reps/sets of HIIT or in the gym)	1%	6%	32%	32%	6%
Keeping a technical component in the drills	2%	9%	20%	31%	15%
Having fun	6%	12%	26%	23%	10%
Other	36%	11%	25%	2%	3%

Table 16. Individual supplementation: When?

	1st choice	2nd	3rd	4th	5th	6th	7th
A large specific top up mid week, far from the matches	17%	20%	22%	4%	6%	6%	2%
A few extras during the week, spread over 2-3 days	32%	25%	9%	5%	3%	3%	0%
Most days of the week, small extras	11%	15%	16%	17%	11%	7%	0%
Something specific as a part of the post compensation	14%	17%	17%	19%	6%	4%	0%
When disqualified, suspended, banned	11%	8%	11%	17%	17%	5%	8%
International break for non selected (if applies)	9%	9%	10%	11%	14%	18%	6%

Table 17. Individual supplementation: factors to be considered

	Doesn't matter	Not Very important	Depends	Important	Very important
Minutes played	0%	1%	9%	40%	49%
Distance from and to next match	1%	3%	6%	44%	45%
Individual profile (physical)	0%	4%	4%	51%	42%
Age	0%	6%	26%	49%	18%
Previous Injuries	0%	4%	13%	42%	42%
Playing position	5%	13%	30%	38%	14%
Player-driven	25%	12%	43%	17%	4%
Others	45%	10%	32%	9%	3%

Table 18. Individual supplementation: what are the benchmarks?

	Doesn't matter	Not Very important	Depends	Important	Very important
Reaching certain thresholds in terms of external load (e.g., % of max speed, distance accumulated)	0%	4%	5%	34%	34%
% Match demands targets	2%	5%	10%	32%	28%
Reaching certain thresholds in terms of internal load (e.g., % of time spent in HR zones)	2%	16%	18%	31%	10%
Based on physiology (e.g., number of reps/sets of HIIT or in the gym)	0%	6%	20%	40%	11%
Keeping a technical component in the drills	1%	8%	20%	36%	12%
Having fun	7%	13%	23%	28%	6%
Other	36%	11%	24%	4%	2%

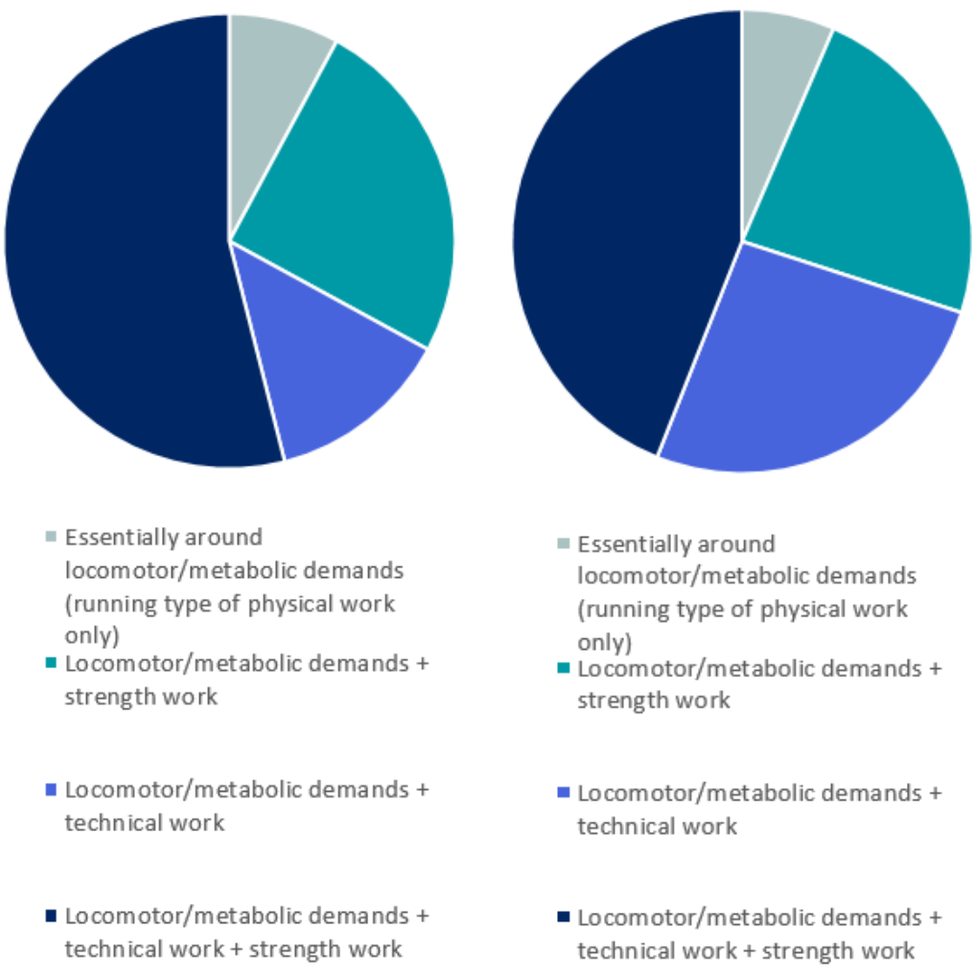

Fig. 8. Substitutes compensation (left) and individual supplementation (right): main contents and formats.

Summary of the main points:

- The very large majority of practitioners reported, irrespective of their periodization and programming model, systematically seeking a daily alternation of training load, orientations and contents.
- This so-called "horizontal" alternation is believed to allow players to work/develop/compensate for some specific physical capacities when others recover, which should help them to remain healthy, fit and competitive throughout the entire season.
- Beyond the alternation per se, there was some consistent agreement in terms of load dynamic within each possible microcycle, with only the longer turnovers allowing practitioners to fit high load sessions mid weeks (i.e., one and two high-load sessions mid week for 6- and 7-days turnovers, respectively). A large majority of practitioners also reported not to program any high load at all during 6-d turnovers, highlighting the importance put on post-match recovery and match preparation cycles over development and acquisition objectives.
- The dynamic of the 2 days before a match (D-2 and D-1) was highly consistent among practitioners and included either a succession of a moderate followed by a low load, or the converse. Importantly, the programming of two consecutive moderate loads was never reported.
- In terms of specific contents for given days, there was some agreement for all turnovers at D-1, for example, when reactive agility is consistently reported to be programmed.
- During 7-d turnovers, there was also clear agreement for D+3/D-4 and D+4/D-3 contents to be oriented toward strength and high-speed running respectively, both on and outside of the pitch.
- For 6-d turnover, the contents of those 2 high-load days are somewhat combined at D+3/D-3, with a greater relative reduction in strength vs. HSR work. In accordance with the above, those neuromuscularly-demanding contents almost consistently disappeared for < 5-d turnovers.
- Only a minority of practitioners (<25%) reported to program max speed work on D-2 when they had programmed HSR contents on D-3. In fact, most practitioners prefer to avoid exposing players to max speed when they may still present posterior chain fatigue from the previous (HSR) day, and therefore, instead program their max speed work on the same day as HSR (i.e., D-3).
- Some types of content, such as those that are mobility and flexibility-oriented, could however be programmed almost all days during any type of turnovers, likely due to the fact that they don't add to the session load and don't create acute neuromuscular fatigue. Mobility and flexibility work may still be programmed with more emphasis on D-2, likely to help the body to recover from the 1 or 2 high loads of the previous days (i.e., D-4 and D-3).
- The programming of both compensation and supplementation work is preferred to be spread over a couple of days, and tends to be aimed at reaching some specific physiological and locomotor targets, while keeping a clear technical component in the drills. The most important drivers of this individual work are mainly minutes played and the position in the microcycle, which logically come before player profiles and preferences.
- Taken together, all the responses collected here show that turnover length is by far the most important driver for daily training load and content programming, both at the team and individual level.
- While there will always be many ways to skin a cat, the current survey illustrates the importance of considering the context (e.g., match minutes, turnover length and the load already associated with the tactical part of the sessions) when it comes to choosing and implementing key training contents.
- Finally, for all the above to happen, performance practitioners need to have a central role in the training decision-making process, and more importantly have the skills and understanding of the sport to be able to offer variable integration strategies (i.e., associated vs integrated approach) in relation to the context (e.g., physical requirements of a tactical session, coaches preferences, time and number of players available etc).

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