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Title/Subtitle

The complexity of defining and assessing the most demanding periods of play in team sports: a current opinion

Running heading

Defining and assessing the most demanding periods

Keywords

worst-case scenarios; peak periods; training load; match analysis; team sports; performance

ABSTRACT

In the context of training load monitoring, the most demanding periods of play (MDPs) have increasingly caught the interest of researchers. However, the MDPs analysis is currently embryonic, raising some conceptual and methodological questions. This current opinion synthesizes the methods used for the MDPs analysis while highlighting conceptual and methodological gaps and proposing a broader perspective on the topic. It is underlined that: 1) the information available on the MDPs is mostly limited to external load (particularly running-based metrics), with scarce research focused on internal load; 2) the metrics have been analyzed in a univariate way, neglecting the multivariate scenarios from which the MDPs emerge; 3) the MDPs are highly variable over time due to the complex interaction between individual, tactical-technical and contextual factors; 4) scarce evidence is available regarding the contextualization of the MDPs from a tactical-technical perspective. Thus, the MDPs would benefit from cross-referencing external load with game moments and tactical actions while avoiding the idea of fixed benchmarks given the inherent match-to-match variability. Practitioners may consider replicating the MDPs (and their contexts) in (some?) training sessions as a complementary prescription strategy (metaphorically, the cherry on top, not the cake). However, the feasibility and effectiveness of such practices warrant investigation.

INTRODUCTION

In the last 20 years, research on match and training load monitoring has increased considerably (19). In this context, several studies were published to analyze "the most intense activity period (for an arbitrarily selected time frame) for a player within training or competition settings" (43) has also increased (e.g., Australian rules football (11), basketball (15), futsal (14), Gaelic football (24), handball (13), rink hockey (14), rugby union (10), and soccer (32, 37, 38)). These periods have been defined as the most demanding periods of play (MDPs) but also as worst-case scenarios (34), most demanding scenarios (15), maximal intensity period (50), peak locomotor demands (3), most demanding passages (41) and peak match demands (51). Regardless, all these concepts aim to identify the most intense physical activities experienced during match-play (32, 51). The match is broken down into shorter timeframes of fixed length (51), and different lengths can be applied (e.g., 10s – 10min) (12, 34, 51). However, the concept of the MDPs seems to be the most adequate to express such moments by avoiding excessive emphasis on the physical factors of performance (32) and allowing a more holistic perspective of match demands. Moreover, the MDPs should best be viewed as complementary to common training programming and prescription strategies, i.e., they should not replace programming aiming to promote general training adaptations but complement such programming.

Why should practitioners identify the MDPs? In soccer, the relative 90-min locomotor values (expressed in m/min) represented approximately 53% of total distance (TD), 16% of high-speed running distance (HSRD), and 6% of sprint distance of the 1-min peak values (38). These results unfold that the distances covered during the MDPs are considerably higher than the mean match values. While practitioners may look at the MDPs as valuable insights into the match's demands, it is unknown whether players' performance during the MDPs will improve in response to specific training regimens, given the lack of studies in this direction (32). The MDPs analysis may enable the planning of training sessions (or parts of it) according to match demands, setting benchmarks to be reached during training drills (15, 34, 50, 51). However, some researchers have criticized this approach, underlining the lack of clarity about what the MDPs represent. Again, the perspective of the current work is to consider the MDPs as a complement to usual programming strategies.

Some current methodological limitations in the MDPs analysis (3, 32, 45) may compromise its practical use for exercise prescription: (1) the MDPs analysis has relied excessively on external load, neglecting internal load (32, 50); (2) only running-based metrics are usually analyzed (e.g., distance covered in predefined speed zones and accelerations/decelerations [Acc/Dec]) (32, 51); (3) the MDPs analysis is usually univariate (identifying the *peak periods* for each variable as separate constructs), despite the likely multivariate nature of the MDPs (32, 51); (4) to date, the lack of studies carried out during training sessions questions the effectiveness of using the MDPs to regulate training demands (32). Likewise, tactical-technical and contextual factors influence players' performance (29, 30, 39, 47) and should be integrated with the MDPs analysis (32). Combined with within-player performance variations, there is potential for considerable match-to-match variability, whereby the MDPs should best be interpreted within a dynamic and evolving range of values (3, 32, 45). In brief, these shortcomings mean that different researchers and practitioners may be referring to different constructs despite using similar terminology. Limiting the analysis to a single load metric is often done for convenience (e.g., GPS-related data that is readily available in most cases). In par with overlooking contextual information underlying each action, this may restrict the comprehension of when and how the MDPs emerge. Finally, players and teams are dynamic entities, and therefore, relying on a single benchmark MDP value should be avoided. Instead, these values should be seen as reference ranges, which are not set in stone and may evolve (e.g., due to performance improvements resulting from adaptations to the training process).

Thereby, practitioners could benefit from using a broader, more holistic conceptual and methodological approach in the MDPs analysis. In this current opinion, the conceptual gaps in the MDPs are discussed, highlighting the need to integrate physical load measures into broader perspectives considering contextual and tactical-technical factors. Moreover, considering the MDPs for training prescription is conceptualized as a complement to existing programming strategies, not an alternative or replacement.

THE MOST DEMANDING PERIODS OF PLAY: CURRENT CONCEPTS AND TERMINOLOGIES

Analyzing the MDPs aims to capture the most intense activities experienced during match-play (32, 51). However, what do *the most intense activity periods* imply? The MDPs are usually quantified based on external load measures (34, 37, 51). Training load is “a multidimensional construct manifested by two causally related sub-dimensions: external and internal load” (20). Thus, the MDPs should fit into this framework since, strictly speaking, it is the manifestation of load within a specific time period and can be expressed by external and internal parameters (19). Accordingly, the MDPs should integrate internal load measures with external load metrics (32, 50) to provide a more holistic perspective. For example, for a given MDP based on external physical metrics (e.g., TD), two players or the same player in a different moment or scenario could present different internal loads and, consequently, different MDPs. However, to the best of our knowledge, only a recent study with youth soccer players included measures of internal load (heart rate [HR] expressed as average HR [HR_{ave}; bpm] and percentage of individual maximal HR [$\%HR_{max}$]) in the MDPs analysis (23).

Whitehead et al. (51) noted that studies on the MDPs mostly used running-based metrics across different team sports, which indicates that the narrow scope of metrics included in the MDPs analysis models is also a shortcoming. According to Impellizzeri et al. (19), the external load measures should be specific to the nature of the exercise undertaken. This suggests that the analysis models should be flexible to integrate the activities of each sport. For instance, jumps are usually neglected in the analysis of many team sports, such as basketball (4) and soccer (2), while limited studies, mostly with rugby teams, include collisions in the MDPs assessment (49, 51). Collisions may potentially be identified by spikes in data from inertial sensors in some GPS devices (e.g., Catapult Optimeye S5, Melbourne, Australia), or through accelerometer- and gyroscope-derived variables (17, 31). However, without open-access details regarding how these algorithms operate, it is difficult to assess how accurately they identify collisions (31). Moreover, it is conceivable that any spike in data may be explained by different factors, including error, and therefore, more research is warranted. Integrating external load data with video analysis could potentially help assess which actions the MDPs correspond to.

Another shortcoming related to the analysis of the MDPs is that most models applied to the MDPs analysis are univariate (10, 32), meaning a mixed model analysis is used for each dependent variable (10). Analyzing the different activities in isolation fails to illustrate the multiple scenarios that induce the MDPs during a specific period (cf. Novak et al. (32)). In a recent exception, Kim et al. (23) used an alternative approach to identify whether external load metrics (speed and acceleration data) matched an internal load metric (HR). While these findings showed trivial differences between the external and internal load metrics (i.e., the effect size was too small for the differences to be noticeable), this was a single study (thereby requiring replication) and HR is only one of many possible internal load metrics. Moreover, this still does not account for the context, i.e., when and how these MDPs occurred.

In summary, current MDPs concepts and analyses seem too narrow, denoting (i) a lack of attention devoted to internal load measures, (ii) external load metrics limited to a restricted number of variables (mostly running-based metrics); and (iii) univariate metrics analysis, overlooking the interaction of the various physical factors that lead to the MDPs. However, the concept of the MDPs can be expanded to provide a more holistic (and potentially useful) set of information that practitioners can act upon.

HOW ARE THE MOST DEMANDING PERIODS OF PLAY BEING ASSESSED?

CURRENT QUANTIFICATION METHODS

Methods such as fixed length and rolling average have been used to capture MDPs (34, 41). The fixed-length method implies splitting the match, from start to finish, into periods of a fixed duration (e.g., 0-59'', 1'-1.59'') (34). Then, to determine the MDPs for each metric, the period with the highest value is chosen (51). In turn, the rolling average requires the instantaneous analysis of raw data, with the number of samples obtained per time unit depending on the frequency of the device being used (10). For example, a GPS with a 10 Hz sampling rate takes 600 samples for 1 min (10, 51). The MDPs can be estimated from the beginning to the end of the match by an algorithm using the current sample and the preceding 599 samples (e.g., 0-600, 1-601, 2-602, 3-603) (10, 34, 51). Regardless of the method used and the time window chosen, the MDPs can be identified by analyzing the whole match or the longest period when the ball is in play (BiP), i.e., taking into account the time in which play is ongoing before the ball leaves the pitch or the referee stops the play (41, 51). BiP has been proposed as an alternative to analyzing the whole match, and it has been suggested as more accurate in quantifying the match's demands (28, 48). The authors claim that BiP enables practitioners to better perceive work-to-rest periods, valuable information for training prescription (28, 48).

Both methods (fixed length vs. rolling average) have been compared in the literature, considering different period lengths (1, 3, 5, and 10 min), and it is noted that the fixed length method usually underestimates the MDPs, regardless of the physical metric or the playing position analyzed (12, 34). Ferraday et al. (12) reported that the fixed length method underestimates the MDPs for HSRD and TD in ~12-25% and ~7-10%, respectively, compared to the rolling average. The longer the MDPs, the greater the observed differences between methods (34). This can be explained because, given the unpredictable nature of team sports, the MDPs are likely to not occur within the exact predefined and fixed periods (16). In this sense, the rolling average is recommended in the assessment of the MDPs since it can better detect intensity fluctuations (12, 34, 51). Within the rolling average method and considering the same period length (1 min), differences were also observed in the MDPs when analyzing the whole match or BiP (41). The whole match approach showed higher MDPs values for HSRD (48 vs. 36 m/min) and Acc/Dec (32 vs 20 m/min), while BIP showed higher values for TD (187 vs 293 m/min) (the values were extracted from figure 3 of the study conducted by Riboli et al. (41), using the WebPlotDigitizer, version 4.6., developed by Ankit Rohatgi). The rapid tactical adjustments by the players when the match stops could be the reason for the increase in locomotor demands (41). It is important to note that the differences between approaches for MDPs longer than 1 min are unknown and could possibly be time dependent. Moreover, BiP is a time-consuming analysis technique, so further studies comparing both techniques are needed to understand whether the cost-benefit is worthwhile.

While the MDPs are often analyzed based on measurable data from a single monitoring tool (external and/or internal load), the so-called "Fine-Tuning" approach proposed by Boullosa et al. (7) could allow improving the diagnosis and predictive capacity of monitoring practices. This approach is defined as "the combined use of different monitoring tools (either objective or subjective and external or internal) that practitioners experience" (7). Importantly, the fine-tuning approach is a conceptual framework, not a specific, validated tool. In the case of the MDPs, the fine-tuning approach could involve combining objective data from external and internal load (e.g., the rolling average to identify the MDPs for both acceleration data and HR) with subjective data (e.g., rating of perceived exertion), while integrating video footage (see section 5) to provide context for the MDPs. This is currently a mere proposal and requires further research to establish its feasibility and effectiveness.

PERIOD LENGTHS FOR ASSESSMENT

The MDPs are analyzed across incremental time intervals (e.g., 10 s – 10 min) (49). For example, periods of 1, 3, 5, and 10 min in soccer are commonly analyzed (42). As expected, as the analyzed period length increases, the relative intensity (distance covered per minute) tends to decrease and vice-versa (25, 41). In Australian football, Delaney et al. (11) found that the MDPs values reached a plateau in periods longer than 5-7 min (depending on the variable chosen). This phenomenon can be explained by the players' being unable to physiologically maintain the same intensity for a long period of time (51). The higher the probability of a break in play (score, stoppage of time by the referee, or the ball going out of play) as the period analyzed increases could also be behind the decrease in relative intensity (51).

To clarify the ideal period lengths to be analyzed, recently, the temporal self-containment of shorter peak match running periods within longer windows was analyzed by Thoseby et al. (46). Owing to the study's low to moderate levels of self-containment, the authors highlight the need for athletes to train the MDPs across varying durations (46). In general, the MDPs of shorter duration do not coincide with those of longer duration. Thus, the period length could be set considering the adaptations practitioners would like to elicit in players (20).

MATCH-TO-MATCH VARIABILITY

Several studies have shown that match-to-match variability in physical performance is a natural phenomenon in team sports (3, 8). In this regard, a recent study in women's soccer showed that the match-to-match variability (represented by the coefficient of variation [CV]) was higher in the 1-min peak periods compared to the absolute values of the entire match, for TD (6.5% vs. 4.6%), HSRD (18.7% vs 15.9%) and Acc/Dec (12.9% vs 11.7%) (3). Other studies have also reported high variability in the MDPs (32, 45). Figure 1 illustrates an example of a soccer player's MDPs match-to-match variability for TD, HSRD, and sprint distance.

However, the match-to-match variability can provide useful insights to identify the minimum and maximum MDPs values calculated using the CV, and consequently set a range of values for the training prescription (45), i.e., instead of the idea of fixed benchmarks, the MDPs can be understood under a dynamic framework. This approach can also be important for identifying changes that appear normal and those that are lower or higher than expected (36) to identify the reasons that led to such values. Identifying a range of values in which the MDPs occur also allows quantifying the number of MDPs events players experience during the match. Importantly, training adaptations during the season may potentially change the range values, and it is possible that the upper limit of such range increased. In competitions with multiple stages, the national stage may impose greater demands than the regional stage, which may also impact the range of the MDPs observed in the matches.

Figure 1 near here

WHAT ARE THE TACTICAL-TECHNICAL BEHAVIORS BEHIND THE MOST DEMANDING PERIODS OF PLAY?

On this topic, the MDPs analysis has been developed in a blind context, without considering the tactical behaviors that support the emergence of such periods (32). Contextualizing the MDPs according to individual and collective tactical issues is necessary to help practitioners create sport-specific drills and provide meaningful stimuli (5), i.e., knowledge of context is paramount for a holistic understanding of the role of the MDPs. Although most studies are limited to quantifying the MDPs (1, 10, 12, 32-35, 37), other studies have recently attempted to contextualize them by synchronizing with video footage (21, 41). This involves identifying the MDPs (e.g., rolling average) and simultaneously observing the tactical behavior of the players during those timeframes (21). The tactical actions can be coded in line with a systematic, integrated approach to quantifying match physical-tactical performance developed by Ju et al. (22). Riboli et al. (41) showed that the MDPs occurred in different match phases according to the players' positions. For example, without ball possession, the MDPs were higher for central defenders (CD) (TD, HSRD, and Acc/Dec) and wide defenders (WD) (HSRD and

Acc/Dec) (41). Conversely, higher MDPs were observed for wide midfielders (WM) (Acc/Dec), wide forwards (WF) (TD, HSRD, Acc/Dec), and forwards (FW) (TD and HSRD) when the team possessed the ball, showing that different positions face different physical demands due to tactical adjustments depending on the match phases (e.g., attack or defense) (41).

Previous research (21) revealed that the contextualized data during the MDPs are position-dependent and that individual and collective tactical actions should be considered in the analysis of these periods. For instance, the principal tactical actions for the CD during the MDPs were *Covering* and *Recovery Run* (see detailed description in Ju et al. (21)). Both tactical actions occurred without possession, and the data coincide with the findings of Riboli et al. (41). *Close Down/Press*, *Run in Behind/Penetrate*, and *Support Play* were the key tactical actions for FW (21). Note that in the study by Ju et al. (21), MDPs were only analyzed for the relative distance above 5.5 m/s, not including metrics such as TD, sprint distance, and Acc/Dec. Questions such as "Can the MDPs vary based on a team's model and game plan?" or "Can the MDPs vary depending on how the models and game plans of the two opposing teams interact?" are worth investigating in the future. In short, MDPs contextualization has the advantage of enabling practitioners to be aware of the tactical actions where they emerge, facilitating the design of training drills that replicate these actions based on the players' position, metrics, and other potentially relevant factors. An expansion of the concept of MDPs to include the tactical-technical context of their emergence may be required to avoid a reductionist approach to understanding match demands and to engage in training prescription.

INTEGRATING ADDITIONAL CONTEXTUAL FACTORS

Additional contextual factors may influence the MDPs values (9), and should therefore be considered when interpreting them (and when using them to prescribe training stimuli). Different studies have analyzed the effects of factors such as the players' position, match location (matches are divided into home or away), match outcome (defined as the final score of the match), match status (defined as the momentary result during the match), starter vs non-starter, among others in performance (1, 6, 16, 32, 37). For example, in soccer, the CD show lower values than the other positions in TD, HSRD, and sprint distance (1, 37, 41). In turn, the central midfielders (CM) have the highest TD values (32, 41). These differences seem to be due to the specific tactical roles of the different positions (21), suggesting that the training drills should be designed according to the specificity of each position (16).

Regarding the match location, the MDPs in away matches are higher than in home matches (1, 37). In contrast, González-García et al. (16) found no significant difference between home and away matches. It is important to note that the studies mentioned are limited to the context and characteristics of the samples, constraining conclusions about practical application. The match outcome and status also affect the MDPs (1, 37). Winning the match (i.e., match outcome is defined as the final result of the match) has a positive impact (greater TD, HSRD, and sprint distance) on the MDPs compared to drawing or losing when considering 1- and 3-min periods (37). Concerning the match status (defined as the momentary result during the match), MDPs seem to be higher when the score is a draw compared to winning or losing (1). Finally, larger TD values were observed for non-starter players (32).

Therefore, the MDPs analysis could integrate the contextual factors, helping the practitioners to identify the sources of variability of the MDPs, to improve the understanding of these specific variables for practice and research. This raises additional questions, such as: (i) can the MDPs vary depending on the presence of congested fixtures?; (ii) can different competitive settings (domestic versus international competitions) influence the MDPs?; (iii) how does travel affect the MDPs?; (iv) may weather conditions (especially temperature and relative humidity) affect the MDPs?; and so on. Such gaps in knowledge limit our understanding of MDPs emergence and, therefore, may result in MDPs being poorly replicated in training sessions (i.e., divorced from their context).

CAN THE MOST DEMANDING PERIODS HELP TO INFORM TRAINING PRESCRIPTIONS?

Despite their current popularity, the MDPs should not be viewed as a panacea that will resolve the problems of load quantification or revolutionize programming – they should best be considered (cautiously) as potentially an extra piece of the puzzle, complementing the existing strategies focused on progressive improvement of performance and/or recovery. Due to the limited number of studies analyzing the MDPs occurrences within training, doubts have arisen about how they could be applied in practice. The frequency, timing, and context of the MDPs during training sessions, how they are distributed throughout the microcycle, and which drills help to generate game-like MDPs are topics that represent valuable research opportunities. If, on one hand, the MDPs (TD, HSRD, sprint distance, and Acc/Dec) are not always hit during training sessions over the week (6, 15), on the other hand, exercises such as small-sided (SSG) and large-sided games (LSG) might surpass the MDPs match values for Acc/Dec and sprint distance, respectively (6, 26). For instance, Sansone et al. (43) developed a study on basketball with youth players and used only one measure of external load (Impulse Load®). The authors found exercises similar to the competitive context-induced higher MDPs values (43). This can be explained because these drills replicate competition-like tactical scenarios (43).

Interestingly, the MDPs are usually higher in the training sessions corresponding to match day minus 4 (MD-4) and minus 3 (MD-3) compared to the competition (match day [MD]) (6, 15). These training sessions occur on the central days of the microcycle, where the training load is typically higher (27, 44). In this way, the practitioners can manipulate a set of variables in the training drills (e.g., drill rules, pitch size, number of players, area per player) to expose the players to appropriate MDPs within the microcycle (5, 40). However, special care must be taken when interpreting the data described above, as the analysis failed to consider the range of values for each player (i.e., they focus on point values instead of an interval of values). If the MDPs are analyzed within a specific range of values, the probability of finding differences between MDPs from training sessions and matches could decrease. Moreover, as previously mentioned, those ranges may oscillate across the season, and, more importantly, the contextual framing and understanding of those MDPs is paramount. Otherwise, prescribing training based on MDPs may result in a vain search for a “physical indicator” divorced from its tactical-technical context.

From a practical perspective, practitioners could identify the MDPs (and their context) to optimize training. By understanding the highest demands (i.e., the MDPs) and in what contexts they emerge, practitioners may potentially use that information to replicate match contexts and improve training prescription to better prepare players for MDPs. Such optimization means adjusting the activities to be performed during training sessions (external load) to generate a specific internal load (mediating mechanism) that causes an outcome of interest (causal exposure-outcome), for example improving aerobic capacity (20), but this should be done under an appropriate tactical-technical context (50). However, practitioners should be careful regarding the dose, i.e., over-emphasizing training prescription based on the MDPs may potentially surpass the intended balance between training and recovering, something that should also be addressed in future research. Importantly, MDPs are not an alternative to general planning and programming, aiming to improve performance while ensuring proper recovery. Instead, training programs focusing on MDPs should consider the frequency, volume, and intensity of actions, offering a complementary approach for practitioners to integrate these factors within a holistic perspective.

FUTURE AVENUES FOR THE MOST DEMANDING PERIODS OF PLAY

The composite construct developed by Novak et al. (32) provides a clear picture of the MDPs and how they should be quantified. However, to be considered scientific, this construct requires three essential characteristics – a label, a constitutive definition and an operational definition (18). In accordance with what has been discussed throughout the article, this section proposes to assign these qualities to the construct. As mentioned earlier, the MDPs would be the construct label, given the holistic overview it presents. From a theoretical standpoint (constitutive definition), the MDPs could be defined as the most intense periods that respond to the external load and are influenced by complex interactions between individual, tactical-technical, and contextual factors (instead of the prevalent, more reductionist approaches). For practical applications (operational definition), the purpose of the MDPs is to capture the periods of the match experienced by the players that fall within a range of values defined using a multidimensional and dynamic approach through external and/or internal load measures, being quantified by methods such as fixed length, or rolling average.

PRACTICAL APPLICATIONS

The main purpose of identifying the MDPs is to improve practitioners' knowledge of the match's demands, and, consequently, to transfer the insights into practice. Importantly, practitioners may still use their usual programming strategies – the MDPs are merely a complement and should not blind practitioners to other goals (e.g., long-term learning and training adaptations). Practitioners should be aware that the MDPs identification involves measures of external and internal load, while also considering their tactical-technical context of emergence. Accordingly, the rolling average appears to be a suitable method to identify the MDPs. Nevertheless, studies analyzing the MDPs in a multivariate way are lacking, so identifying the minute of the match in which the MDPs occur could be an alternative approach to understand which activities lead to the highest internal response. Crossing these data with video analysis, practitioners can better understand the contexts under which the MDPs emerge (e.g., the when, how, and why). The match-to-match variability should also be assessed, and it is suggested that practitioners use a database to record the MDPs so that the evolving range of values can be monitored over time (updated every match). The linear mixed model can be a method of statistical analysis to set the range of values based on CV, and to identify whether the values of a given match are higher or lower than expected in comparison with the retrospective match values, the method proposed by Oliva-Lozano et al. (36) can be used.

While hard conclusions are difficult to draw, it seems reasonable that practitioners may wish to design parts of training sessions to ensure players hit the MDPs, considering both *ingredients*: intensity and frequency. The use of the MDPs to prescribe parts of the training sessions (or drills) should not, however, replace the core concept of designing training to achieve specific adaptations, especially if non-contextualized MDPs values are used. Considering the MDPs in this context is akin to putting the cherry on top of the cake – training should first and foremost focus on the adaptations for the most common demands of a match, and only secondly worry about the MDPs, which will occur only sparsely. Still, preparing the players to face such demands may be important, not only from a performance perspective, but also from an injury prevention perspective.

From a load management perspective, it could make sense they take place in the middle of the week, as the training load tends to be higher on these days and decreases on the days before the following match. However, this may vary depending on the momentary goals for the microcycle and the stage of the competition. Some teams may, depending on how the competition is organized, implement the MDPs more frequently in the microcycle. The programming of the MDPs intensity and frequency for each training session weekly should be tailored in accordance with the range of values set for the individual players. Finally, though it may sound conflicting with what has been discussed in this article, univariate analysis can be useful in specific settings when prescribing training (e.g., metrics such as sprint distance). For example, in exercises that replicate match situations but are focused solely on speed. However, this should be implemented with caution, to avoid an overly reductionist approach to training. The introduction of video footage can assist practitioners to identify behavior patterns according to players' positions during the MDPs, to be replicated during training drills. Figure 2 synthesizes how the MDPs can possibly be identified and applied in training sessions. It was structured logically, starting from the assessment to the prescription of the MDPs.

Figure 2 near here

CONCLUSIONS

Research on the MDPs would benefit from a broader conceptual and methodological perspective, integrating internal load measures and exploring multivariate analysis. In addition to the MDPs assessment for different external and internal load metrics, research should integrate video analysis to contextualize the MDPs from a tactical-technical perspective and avoid a reductionist approach to the MDPs. This way, practitioners can apply the analyzed data to help monitor and develop certain training drills, allowing a better benchmark between the training and match situations. However, given its limited nature and current limited research, the MDPs should be considered a mere complement to usual training practices. Practitioners should also interpret the MDPs dynamically to implement an evolving benchmarking process, considering how it may change over time (e.g., match-to-match variability, within-season evolution). Above all, the MDPs should not be looked at as a “single” approach to use to monitoring load but rather as one element within a holistic framework that may provide valuable insights for training prescription.

Figure captions

Figure 1. An example of a soccer player's 3-minute MDPs match-to-match variability for TD (A), HSRD (B) and sprint distance (C) across thirty matches. The figure also shows the z-scores (D) for each variable, so that zero represents the mean and one represents the standard deviation. The z-scores are useful for comparing different variables, as well as for easier interpretation and comparison of the MDPs performance on an individual basis. The data was generated in RStudio (version 2023.12.0+369 "Ocean Storm", Boston, Massachusetts) based on the CV reported by Novak et al. (32) for TD (6.2%), HSRD (25.2%) and sprint distance (46.1%).

Figure 2. Synthesis of how to analyze the most demanding periods of play (MDPs) and use them in training prescription. The graph represents the match, and the red dots depict the MDPs, demonstrating that they are higher than the mean values for the whole match. The dialog boxes highlight the factors that influence the MDPs, the measures and the methods used to identify the MDPs, the match-to-match variability, and the training prescription guidelines.

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