Acceleration and deceleration demands during training sessions in football: a systematic review

Abstract

The aim of this review is to summarize the current scientific knowledge about acceleration and deceleration demands during football training. A systematic search of three electronic databases (PubMed, SPORTDiscus, Web of Science) was performed to identify peer-reviewed relevant English-language articles, following PRISMA guidelines. All acceleration and deceleration data were analyzed and organized into four categories: i) training drills variables (i.e. manipulated drills variables such as number of players in small-sided games), ii) training exercises (i.e. different drills such small games or circuit training), iii) players' positions (i.e. demands for each playing position) and iv) training schedule (i.e. training sessions presented as microcycles, season sections or full season). Full-text articles of 42 studies were included in the final analysis. Players' level included: amateur, youth, semi-professional, professional and elite players. All playing positions were considered, including goalkeepers. Six different global position systems brands were used, with the majority measuring data at 10 Hz. Different thresholds and intensities were used in several papers. Lower acceleration and deceleration intensities occurred more often than higher intensities in all four categories. Different exercises elicit different demands and small-sided games presented higher acceleration and deceleration demands than circuit training and other running based drills. Furthermore, manipulating drills variables, as reducing or increasing number of players in small-sided games increase or decrease demands, respectively. Additionally, wide playing positions, such as fullbacks, are generally exposed to higher acceleration and

deceleration demands. From a planning point of view, acceleration and deceleration demands decrease as match day approaches.

Keywords:

Small-sided game, training load, training drills, GPS, soccer, microcycle

Introduction

Football is an intermittent sport in which players repeatedly perform low and high intensity activities, with concomitant sport specific technical actions (1,2). Players need to perform many accelerations (ACC) and decelerations (DEC) during the match which impact the players' physical level and their performance during the final minutes of the game (3,4). ACC and DEC are categorized as external training load and are usually monitored with Global Positioning System (GPS) technology (5–8). The importance of ACC and DEC for competition has been highlighted due to the high mechanical and metabolic demand of these actions which players have to perform repeatedly (9,10). The load from ACC and DEC constitutes a considerable portion of the total load for a player during match play (11) and are associated with post-match muscle damage and fatigue indicated by changes in creatine kinase (increase) and countermovement jump performance (decrement) during recovery time (12). This may be justified because ACC and DEC elicit higher metabolic and mechanical loads than constant speed running in football players (13–15).

To be physically prepared for the match, players must train to develop specific physical skills (e.g., lower limb muscle power, ability to change direction). The knowledge of such match demands can lead professionals to apply the approach “train as you play” (16); however, it appears that football players frequently do not train with

the same intensity as they compete, because higher physiological demands were found during competition than during training sessions (17,18). This is particularly true since many variables that are present in football training can affect ACC and DEC volume and intensity such as football drills used, players' positions and coaching philosophy (19). For instance, previous studies found that the distances performed during ACC and DEC could differentiate between positions during training, where higher distances were reported for central midfielders and lower distances for central defenders (20). Moreover, different ACC and DEC demands were found with variations in playing formations across different playing positions (21). Since training specificity is important to improve performance and secure optimal adaptation (22), a review on ACC and DEC demands during training may grant key information for coaches and practitioners, which could better plan and structure their training sessions.

Despite the great interest in ACC and DEC demands in football during the recent years, to the best of our knowledge, there is a lack of a practical and concise approach in scientific research that can summarize this important topic. Due to the importance of ACC and DEC in physical performance and training load, a systematic review on this topic can help practitioners and researchers in training design and in data analysis. Variations in ACC and DEC demands across a training week (with reference to the match day) and in different players' positions have not been systematically reviewed to date. These items, as well as different exercises and their variables adaptation to specific objectives, are the four main categories of both planning football training and conducting scientific research. Therefore, the aim of this review is to summarize the current scientific knowledge about ACC and DEC demands during football training.

Materials and Methods

The current review was conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis) guidelines [23] and is described in Figure 1.

[Figure 1 near here]

Search strategy

Systematic searches of three electronic databases (PubMed, SPORTDiscus, Web of Science) were conducted to identify peer-reviewed articles published in the English language between 1 January 2010 and 30 June 2020. Initial search was performed in different days for each electronic database (PubMed: June 26, 2020; SPORTDiscus: June 30, 2020; Web Of Science: June 28, 2020). Search terms were accelerat* and decelerat* with "AND" and "OR" with related terms as presented in Table 1.

The selection of the terms presented was based in two factors: from reviews and original articles keywords previously read; and from preliminary search of terms in databases.

[Table 1 near here]

Studies screening

All search results were initially exported to Microsoft Excel (Microsoft, Redmond, WA, USA). Eligible studies were identified throughout different steps. First, duplicates were removed, after confirmation of title, year and author(s). Then, title and abstract were analyzed according to exclusion criteria reported in Table 2 and if any of these

were clearly present the study was excluded. If an abstract was not clear for exclusion, the article remained selected for the next stage. In the final stage, studies were fully analyzed and excluded if exclusion criteria were met, or inclusion criteria were absent.

[Table 2 near here]

Risk of bias

The risk of bias assessment followed Cochrane recommendations and used the Risk Of Bias In Non-Randomized Studies of Interventions tool (ROBINS-I) (24). This tool uses different domains that results in a classification of low, moderate, serious, or crucial risk of bias for each domain and an overall assessment of each study. Domains of ROBINS-I are: 1) Bias due to confounding; 2) Bias due to selection of participants; 3) Bias in classification of interventions; 4) Bias due to deviations from intended interventions; 5) Bias due to missing data; 6) Bias in measurement of outcomes; 7) Bias in selection of the reported result. Finally, an overall risk of bias is provided. To perform this assessment, each study was analyzed by two authors, with a third author resolving disagreements, following the guidelines from the detailed guidance (25). Detailed assessment can be consulted in supplementary information (Table S1). Since this review includes a high number of studies, we chose to provide a summary plot (Figure 2), with each domain and the overall risk of bias assessment. To do so, we used Risk-of-bias VISualization (robvis) (26).

Statistical analysis

This systematic review does not have any meta-analysis or statistical analysis between studies because different GPS brands, different ACC and DEC metrics, different ACC

and DEC thresholds were used. The authors decided that the risk of bias for a meta-analysis and related between analyses were too high and any analysis could have been biased.

Results

Search results

Figure 1 reports the selection of 42 studies for this review from a total of 3926 articles. Two of the selected studies were not sufficiently clear in their ACC data and the corresponding authors were contacted via e-mail for further information. Information was provided and both studies were included in this review. This review does not differentiate between GPS and Global Navigation Satellite System technology (8).

Studies characteristics

Descriptive characteristics of the selected 42 studies are presented in Table 3. Regarding samples, the main level categories were professional level (36%, *n*=15) and elite (17%, n=7). Other labels were used and can be seen in supplementary information (Figure S1). From the 835 football players, 56 (7%) are female football players. Average ages from all studies ranged between 16 and 28 years old. Player positions were identified in different studies, including goalkeepers.

Different equipment was used by the selected studies, with the majority, 69% (*n*=29), using GPS with a sampling frequency of 10 Hz, followed by 17% that used 15 Hz (*n*=7), 7% (*n*=3) using 18 Hz, 5% (*n*=2) using 20 Hz and 2% (*n*=1) using 5 Hz. One study adopted 15 Hz sampling frequency for other variables but used 5 Hz when collecting ACC data (27). Additional information regarding the equipment's used can be found in supplementary information Figures S2 and S3.

151

152 ***[Table 3 near here]***

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154 ***Acceleration and deceleration measurements and thresholds***

155 21% (*n*=9) of the 42 selected studies did not provide DEC data. The presented
156 ACC/DEC data was analyzed through different variables (e.g. number, distance,
157 frequency) that can be found in supplementary information (Figure S4). Additionally,
158 different intensity thresholds were used to measure ACC and DEC, which are detailed
159 in Table 4. To fill this gap, we created 4 main categories to interpret the data: i) training
160 drills variables (i.e. manipulated drills variables such as number of players in small-
161 sided games), ii) training exercises (i.e. different drills such small games or circuit
162 training), iii) players' positions (i.e. demands for each playing position) and iv) training
163 schedule (i.e. training sessions presented as microcycles, season sections or full
164 season).

165

166 ***[Table 4 near here]***

167

168 ***[Figure 3 near here]***

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170 ***Training drills variables***

171 Typically, SSG formats increase ACC and DEC demands when a reduced
172 number of players (27–36) and smaller pitch sizes (27,37,38) are used. However, some
173 exceptions were found for 5vs.5 that had less ACC > 2.5 $m \cdot s^{-2}$ than 7vs.7 format (33),
174 while more maximal ACC and DEC were found in 10vs.10 than in 7vs.7 and 5vs.5
175 (36); finally, short wide pitch size (25x66m) elicited more moderate intensity ACC and

high intensity DEC than short narrow size (25x40m) (38). Contrasting results such as higher demands in medium or larger pitches sizes, were also registered, but that can be due to the different measurement used to assess demands (ACC and DEC distance covered) (39,40) or goalkeeper demands (41).

SSG can also be manipulated by changing specific rules; for instance, numerical superiority decreases ACC and DEC demands (42,43), especially for the floaters (35,43,44). Another common rule used during SSG is the number of ball touches allowed; however, this review reports conflicting results were found in this review (45–47). SSG are often proposed in two formats, first to maintain the possession of the ball, which reported high demands in one study (48); second, to score goals, which reported more ACC and DEC than possession games in other two studies (33,36). The presence or absence of fatigue was also analyzed and, the only paper reported in this review on this specific topic reported that mental fatigue can affect ACC and DEC demands (49). Finally, drills were also conditioned by the relation of work and rest times. While one study found more ACC in the regimen of 3 sets of 6 minutes than 6 sets of 3 minutes in a 5vs.5 SSG (both with 2 minutes of rest) (50), opposite results were found with the same regimens in another study (51).

Regarding efforts, ACC had higher values in some studies (29,31,32,37,39–41,45,47,51), while DEC had in others (28,30,44,48,49,52). Finally, low ACC and DEC intensities occur more frequently than higher intensities (29,33,39,43,45,47).

Training exercises

When comparing training drills and matches, higher ACC and DEC demands were found in SSG (29–31,53), in friendly matches (54) and official matches (55). Matches (official and friendly) imposed higher DEC demands in female players, except

in central midfielders, while technical-tactical training elicited higher ACC demands (56). Contrasting with these findings, friendly matches elicited the lowest ACC and DEC demands in comparison with training sessions that included SSG, large-sided games (LSG) and mini-goals games (57). Between training protocols, the same study reported the lower DEC demands in the training session composed with SSG, circuit training and LSG, while the lower ACC demands were found in the training session with mini-goals, circuit training and LSG. Additionally, circuit training was also the least-demanding drill when compared with SSG, LSG, mini-goals games and friendly matches (or match simulations) (31,53). Furthermore, higher ACC and DEC distances were covered during 1vs.1 and 2vs.2 SSG formats than in continuous and shuttle running drills (58,59). In a study investigating female players, warm-up drills and SSG elicited the lowest DEC and ACC demands respectively compared with matches and technical-tactical training (56). Moreover, two studies compared different training sessions with matches and both registered higher demands in matches (54,55). Endurance sessions (with positional games, LSG and match simulation) had higher relative ACC than strength-based (with positional games, SSG and medium sided game) and speed sessions (positional games, LSG, tactical drills and free kicks) (55). Additionally, a further study found lower ACC and DEC demands in tactical sessions and reserves fitness sessions, respectively (54).

More ACC were registered than DEC (29–31,53,54,57–59), except for tactical training, where high DEC distance per hour (<-3 $m \cdot s^{-2}$) was higher than high accelerations distance per hour (>3 $m \cdot s^{-2}$) (54). Lower intensities were more frequent (29,54,59), except for higher distance covered in maximal DEC (≤-3 $m \cdot s^{-2}$) than high DEC (–2 to -3 $m \cdot s^{-2}$) during 1vs.1 SSG (59).

Players' position

Goalkeeper's demands were analyzed in two studies, reporting higher ACC and DEC demands in the training sessions in the middle of the week (in comparison with matches and other sessions) (60) and in small SSG formats (32x23m > 50x35m) (41).

Players in central positions (central defenders, midfielders and attackers) performed fewer ACC and DEC efforts than in wide positions (fullbacks and wide midfielders) (20,30,34,56,61). Some exceptions were found in attackers with more DEC in 5vs.5 SSG (30); central midfielders in compensatory session (MD+1C), MD-4 and MD-1 (61); and offensive midfielders in LSG (30).

Finally, starters performed more ACC and DEC efforts than non-starters (60).

Training schedule

For studies analyzing the training schedule, this review found that the MD-4 (20,60,62), MD-3 (62) and MD+1C (61) were the most demanding sessions of the week; while MD-1 (20,61,62) was the least demanding, with the exception for goalkeepers which reported the lowest demands during matches (60). One study, that compared training demands of the team with a player during his recovery from an injury, found that team and recovery player had different ACC and DEC demands during the week session (63).

In female players, no microcycle data was available. However, one study divided the season into preseason, the most demanding period of the season, early season, and late season – the least demanding (64).

Overall, this review found that more ACC were reported than DEC (20,60–62,64,65), with one exception (65). Lower ACC and DEC intensities occurred more often than higher intensities (62,63,66).

Discussion

The main purpose of this review was to provide a comprehensive summary of ACC and DEC demands during football training, which may help practitioners in their daily practice and to establish new lines of research. This review included male and female football players at different levels such as professional, semi-professionals, amateurs and youth players. Different players' positions were also analyzed, including goalkeeper, which is not common in this type of review. This review analyzed four main categories to promote a more comprehensive interpretation of different factors and conditions that may influence ACC and DEC: training drills variables, that consider the manipulation of drills variables that might influence ACC and DEC; training exercises, which addresses different exercises choices to implement in training sessions; players' positions, describing ACC and DEC demands according to tactical positions; and finally, training schedule category, which analyzed the training sessions distribution across a microcycle, organized according to the distance to the competition and the organization of that weeks during the season (Figure 3). This systematic review shows that ACC and DEC efforts are influenced by different variables within each of the categories previously presented. Regarding action frequency, ACC actions were more frequent than DEC, independent of the category analyzed. Lower intensities of ACC and DEC efforts tend to occur more often than higher intensities efforts during training sessions. More ACC were found in competition than in training sessions (11,67,68). Regarding the four categories, SSG present higher ACC and DEC demands than other drills such as circuit training, especially when played in smaller formats (by manipulating number of players or pitch size) in comparison with larger formats of SSG; wide playing positions, as fullbacks, may be exposed to more ACC and DEC

demands; and finally, middle of the week training sessions are the most demanding sessions of the week regarding ACC and DEC demands and these demands decrease as match day approaches.

Acceleration and deceleration measurements and thresholds

This review reports that the intensity thresholds were not the same across the studies analyzed (Table 4). Without a standardized classification of ACC and DEC thresholds, it is very difficult to perform a comparison among studies or to provide definitive statistical analyses and draw relevant conclusions for practice. Additionally, intensity classification can also be a problem when establishing conclusions. As previously stated, it is important to clarify thresholds and intensities and avoid arbitrary thresholds to classify intensities (69). A solution for this issue was suggested by Abbott et al. (70), who proposed the use of player-based ACC intensity thresholds, as it appears to represent individual intensity more accurately than generic thresholds. Briefly, these authors divided the players in 3 groups (low, medium and high accelerative capacity, obtained as <1, ± 1 and >1 standard deviation from the mean, respectively), according to their maximum ACC testing scores. Abbott et al. categorized ACC intensities as low (25-50%), moderate (50-75%) and high-intensity (>75%) ACC as proposed previously by Sonderegger et al. (71). In the latter, authors have presented the quantification of ACC percentage which takes in account both maximum voluntary ACC and initial running speeds, however, DEC would still be disregarded in this proposal, as stated by the authors. This approach could offer some benefits such as players' individualization based on their maximal effort, but it could also limit the comparison among players and studies since different thresholds would be used for each player (69).

It would be beneficial for coaches and researchers to have a common approach and to use specific thresholds to better quantify ACC and DEC in football. Sweeting et al. (72), reported in their review that there is no justification to the chosen thresholds used in the literature, which is a very important limitation. Since no consensus on how to define ACC and DEC thresholds exist, some findings interpretation could be biased. The same authors recommended thresholds of equal bandwidth to solve this issue. For example, for velocity thresholds, specific bandwidths of 0-5, 5-10, 10-15, 15-20 and >25 $km \cdot h^{-1}$ were proposed, however, no ACC and DEC bandwidths were suggested so far.

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Another issue may arise with ACC zones and intensities classification, for example, ACC intensities > 3 $m \cdot s^{-2}$, which could be classified as high or moderate. Considering an example from velocity analysis, it is possible to see that sprints have been previously classified as events > 20 $km \cdot h^{-1}$ and > 25 $km \cdot h^{-1}$ for female and male football players respectively (73) and this could be an issue because researchers and practitioners could interpret external loads events using different terminologies (e.g., moderate or high for the same intensity). A second issue could relate to the use of open-ended thresholds, such as > 2 $m \cdot s^{-2}$, > 3 $m \cdot s^{-2}$, > 4 $m \cdot s^{-2}$; considering again velocity analysis, it is possible to find papers reporting open-ended thresholds such as high-speed running > 15 $km \cdot h^{-1}$ and sprint > 25 $km \cdot h^{-1}$, which may lead to biased interpretation of high-intensity demands (74). Considering both these issues, this review suggests using specific thresholds bandwidth such as 0-0.99, 1-1.99 $m \cdot s^{-2}$ and so on avoiding using open-ended thresholds; in this way, ACC and DEC quantification could be more accurate and specific. Finally, this review suggests avoiding interpreting ACC and DEC intensities as low, moderate or high, but simply quantifying using specific thresholds.

Training drills variables

SSG drills are very common in football training and can be adapted according to coaches' objectives. For instance, an increase in the number of players may lead to fewer technical actions per player (75). Similarly, other variables such as pitch size, rules and work to rest ratio can also be modified to manipulate SSG and aim different training objectives (76). For example, the presence of goalkeepers and floaters elicited more DEC than ACC efforts (28), while the opposite was found without goalkeeper but with floaters (44) (more research is needed on this topic). Practitioners should be aware that the mere inclusion or exclusion of goalkeeper in SSG may increase or decrease the drill intensity (77). In this review, ACC and DEC demands seem to increase as the SSG format decreases in number of players or area per player (28–30,32,34–38,42,43). Similar results were found when comparing 4vs.4+goalkeeper SSG and 8vs.8+goalkeeper SSG format (78). However, the implementation of SSG during training present also some limitations: first, they require a high technical and tactical levels to achieve the desired physical intensities (76), second, this can negatively affect the long-term physical development of the players by limiting the intensity during training. Last, floaters (when used during SSG) may need physiological compensation due to their lower ACC and DEC demands reported in previous studies (35,43,44).

Training exercises

Although SSG are very common in football, there are several other training exercises used by practitioners. Different training protocols, such as sprint training and speed endurance training, have been shown to improve players' conditioning (79–81). In our review, SSG presented higher ACC and DEC demands than other drills such as

continuous and shuttle running (58,59) and circuit training (53). Moreover, when circuit training was present in a training session, ACC and DEC demands were lower than in sessions comprising only SSG (57). Additionally, more DEC but less ACC were recorded in SSG in comparison with warm-ups and tactical-technical training (56). Warm-up also had the lowest training load, monitored with different methods (i.e. rate of perceived exertion and heart rate) but not ACC and DEC, in comparison with technical-tactical training and physical training (programmed session that was devised to enable players to cope with the physical demands of match-play) (82).

Finally, friendly matches or match simulations were also analyzed in this review. This type of training session can be used to simulate competition and regarding ACC and DEC demands, that appears to happen (54–56). However, in some other studies, friendly matches reported lower ACC and DEC demands than other drills (29,57). These conflicting results may result from how the friendly matches were conducted, for instance the level of the opponents could play a key role for the demands of the match. As previously said, competition tends to be the most demanding session of the week and it could be expected that friendly matches replicate these intensities, however, many factors could play an important role (such as team's motivation, opponent's level, etc.).

Player's positions

Previous research has highlighted central defender as the position with lowest ACC and DEC demands during matches (11,21,83,84) but contrasting results were also found (85,86). In this review, central defenders reported a lower number of ACC and DEC but not consistently (20,30,34,56,61). Generally, central defender and forwards were predominately less exposed to higher ACC and DEC demands in comparison to

fullbacks and midfielders (20,30,34,56,61). Two studies analyzed ACC and DEC during football matches and reported more ACC and DEC occurrences for wide players than central players (11,83). Similar results were found in other studies (84,85,87), with wide midfielders and fullbacks performing more ACC than central defenders and midfielders. Instead, in the de Hoyo study (87), strikers (or forwards) were the players with more ACC which could be due to specific tactical demands (e.g., due to counterattack situations created by the team). Since competition demands elicit different demands across player's positions (88), training drills should aim to prepare players to meet these specific requests. For instance, according to the results of this review, external positions such as fullbacks and wide midfielders may require higher physiological preparedness to match the ACC and DEC demands of competition.

Little is known about goalkeeper's ACC and DEC demands in football training and this may be because goalkeepers training sessions are mainly based on technical work (89) or actions such as jumping and diving and these demands come with no surprise because of the characteristics of the role (90,91). According to our findings, goalkeepers performed more ACC and DEC in training sessions than in matches.

Training schedule

Considering the training week, ACC and DEC demands decrease as match day approaches and this strategy is frequently used in team sports to avoid pre-match fatigue and increase match preparedness (92–94). The middle of the week, MD-4 and MD-3, and the compensation session (MD+1C) were the most demanding sessions and MD-1 the least demanding. Martín-García et al. (61) investigated compensatory and recovery sessions and presented the compensatory session as the most demanding session of the week. These results are aligned with the evidence that defines matches as the most

demanding session of the week and the main cause of the training load difference between starters and non-starters (95–97). Furthermore, these differences could lead to non-starter players being under-trained (98). In this sense, when conducting a compensatory session for non-starters, high ACC and DEC demands should be planned (to compensate for the load missed during the match). Recovery also plays an important role, as ACC and DEC actions during matches were associated to fatigue that lasted up to 72h after the match (99). As so, in sessions immediately close to the match, training exercises should be carefully chosen, to avoid excessive ACC and DEC demands. For example, small (area and number of players) SSG should be avoided in these days. In this review, ACC actions were predominant in comparison with DEC during training, the opposite of what a recent review revealed when analyzing ACC and DEC demands in matches (100). Finally, football players reported a predominance of low intensities in ACC and DEC efforts compared to higher intensity efforts during training sessions, similarly to what happen in competition matches (14,101) - this comes also as no surprise as low intensity activities are more common than high intensity activities.

Limitations and future directions

This review is not without limitations, first, the lack of consensus when establishing ACC and DEC thresholds limits the quality and depth of the analysis. Hence, future research should prioritize the standardization of ACC and DEC intensity thresholds. As previously stated, applying bandwidth zones instead of intensity or zones classification could help improve research data comparison and analysis. As an example, instead of presenting ACC and DEC data as high, moderate and low intensity, one can present the number of ACC and DEC efforts within each bandwidth (0-1 $m \cdot s^{-2}$; 1-2 $m \cdot s^{-2}$; 2-3 $m \cdot s^{-2}$; etc.). With this strategy, comparisons between measurements would be more precise

and teams could classify intensities of their own players. However, it is important to notice that this would not be a definitive solution because the assessment of ACC and DEC with GPS is not absent of concerns. As stated by Buchheit et al. (102), ACC and DEC measures can differ between models and between units. Second, not much information about ACC and DEC demands in female football training was reported in the literature, therefore a major part of the studies reported in this review included male participants. Future research should investigate female football players' training demands. Third, future studies should investigate the ACC and DEC demands during training of specific roles, like floaters, because the knowledge regarding roles is currently very limited. Finally, as scarce evidence exists on goalkeepers ACC and DEC demands representing an important limitation, future studies should investigate their demands to offer a better understanding of goalkeepers training needs.

In conclusion, this review summarizes the current knowledge about ACC and DEC demands in football training. Since football drills can be adjusted according to different tactical and technical goals, different ACC and DEC demands can be expected. SSG is a training drill widely used in football training and elicits higher ACC and DEC demands than other training methods such as circuit training and running-based drills and its format can be modified to match specific objectives. SSG formats with few players and/or small pitch size tend to increase ACC and DEC demands and these demands can also differ for each playing position, for instance, central positions appear to be subject to fewer demands than players that play in wide positions. Considering the training week, ACC and DEC demands decrease as match day approaches and this strategy is frequently used in team sports to avoid pre-match fatigue and increase match preparedness. Moreover, ACC and DEC demands were greater

during MD-4, MD-3 and MD+1C, while MD-1 was the least demanding. Lastly, this review found that the match represents the most demanding session of the week, therefore a compensatory session could be used to avoid under-loading non-starter players.

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Figure 1. PRISMA flow diagram

Figure 2. Summary plot of the risk of bias for each seven domains and the overall risk of bias ROBINS-I tool.

Figure 3. Categories for data analysis.

SSG = Small-sided games

CT = Circuit training

MD = Match day

MD-4 = Match day minus 4 days

MD-1 = Match day minus 1 day