Manuscript Title: The physical demands of professional soccer players during in-season field-based training and match-play

Brief Running Head: Physical demands of soccer players

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ABSTRACT

The running demands of professional soccer match-play are widely established, with players performing various high-intensity actions interspersed with periods of low-intensity activity. However, the demands of in-season training sessions, and how closely they relate to match-play, remain largely unknown. The purpose of this study was to investigate the running demands of professional soccer players during in-season field-based training sessions and matches, and to examine whether the demands of training are similar to those of competition. Across three competitive seasons, 27 professional soccer players from the Australian A-League (age: 24.9 ± 4.7 yr; body mass: 79.9 ± 7.5 kg; height: 1.82 ± 0.06 m) were monitored during in-season field-based training (n = 184) and competitive matches (n = 57) using global positioning system devices. Non-parametric Mann-Whitney U-tests were used to compare the movement characteristics of training to matches, with significance set at $p \leq 0.05$. Results indicated that when compared with matches, players spent significantly more time performing low-speed activities, and less time performing high-speed running, during training ($p < 0.001$). The relative duration of standing was significantly greater during training than match-play (48.0% vs. 2.7% total time; $p < 0.001$). The frequency of sprinting efforts was lower during training when compared to match-play (2.1 vs. 8.3 efforts per hour), as was the average speed (68.5 m·min$^{-1}$ vs. 123.1 m·min$^{-1}$; $p < 0.001$). These findings reflect the nature of in-season field-based training practices, where low-intensity activities are promoted to facilitate recovery from matches. Due to the importance of repeated sprint performance in matches, these data highlight the need to examine current training practices, and ensure sufficient high-intensity training stimuli are employed during the competitive season.

Key Words: Time-motion analysis, team sport, global positioning system, running, training load
INTRODUCTION

For soccer training to be effective, it must specifically relate to the demands imposed by match-play (30). Several contemporary time-motion investigations have detailed the physical demands of professional soccer players during competition (26-28). Research has established that professional players cover a distance of approximately 8500-13000 m at varying movement intensities during a 90-minute match (35), including 1000-1400 unpredictable changes in locomotor activity, which occur every 3-6 s (26,31). As a result, it is widely accepted that training for professional players should focus on improving both aerobic and anaerobic capacities, as well as enhancing the ability to perform repeated bouts of intense exercise and recover rapidly between these bouts (5). The challenge for soccer and strength and conditioning coaches is to ensure that appropriate training strategies are implemented to train for these demands. In order to achieve this, it is important that strength and conditioning staff examine the efficacy of training methods by monitoring players during practice, so as to ensure they are being applied a suitable and specific training stimulus.

Analysis of player movement patterns using global positioning system (GPS) technology has become increasingly popular in intermittent team sports (4). While it should be acknowledged that the reliability of GPS devices may decrease when resolving distance covered at high speeds (10), the portability and simple analysis of data make this technology an attractive monitoring tool for strength and conditioning staff. GPS-derived measures have been recently used to quantify the external-training load of professional soccer players during in-season field-based training (33), and can provide a simple means to quantify the running demands of players during training. While these training-based data provide coaches with practical information detailing the physical stimulus applied within a training session, to the authors’ knowledge, no research has compared the physical demands of field-based training sessions for soccer with match-play data.
Comparisons between field-based training sessions and match-play have previously been completed in Australian football (11), rugby union (15) and rugby league (14). Dawson et al. (11) reported that professional Australian football players spent more time standing and less time walking (as a percentage of total movement time) during training than in matches. These findings may reflect the inherent nature of field-based training for team sports, where low-speed activities can be accounted for by time spent listening to coaching instructions, waiting to perform a drill, or breaking to rehydrate (11,15). Furthermore, both Dawson et al. (11) and Hartwig et al. (15) reported the duration of fast run and sprinting activities performed by Australian football (<6 s) and adolescent rugby union (~2 s) players during training were similar to those in match-play. However, these studies also reported that the frequency of these high-speed efforts during training was lower than observed in matches (11,15). Hartwig et al. (15) suggested that the frequency of sprint efforts during training was insufficient to elicit training adaptations, and proposed that high-speed match demands should be simulated during training.

Gabbett et al. (14) reported game-based training (i.e. small-sided games) offered the most match-specific form of conditioning for professional rugby league players, as they provided similar collision and repeated high-intensity effort demands to match-play. Typically, in-season training for soccer also includes small-sided games to facilitate a conditioning effect in conjunction with technical and tactical development (16,29). However, Gabbett et al. (14) also proposed that excessive use of game-based training in a non-periodised program may result in injury, illness, fatigue, or overtraining. This is a pertinent consideration for soccer players, as the work they perform during a game will also provide a conditioning effect. Potentially, a lower volume of higher intensity efforts during in-season field-based training, combined with in-match conditioning, may be sufficient to maintain required fitness characteristics for players.
Nevertheless, to optimise in-season team sport performance and minimise the risk of overreaching or overtraining, it is vital to ensure appropriate periodisation of training stimuli between competitive matches (20). The focus of this competition phase is often recovery from high-intensity match-play and maintenance of the physiological capacities which were trained vigorously during the preparatory cycles (9,21). Coaches typically do not employ heavy training stimuli in the days immediately prior to or following competitive match-play, in order to avoid excessive physical and psychological strain (20). Nonetheless, it is still important to ensure appropriate bouts of high-intensity activity are incorporated into in-season training sessions to maintain players’ fitness characteristics. In-season field-based training for professional soccer therefore typically includes passing drills, shooting practice, and small-sided games, focused on acquisition and refinement of technical and tactical skills, and aerobic and anaerobic conditioning (1,25,33). However, whether these training practices combine to provide a sufficient training dose for professional soccer players during the competitive season has not been clarified.

While the physiological and time-motion characteristics of various training drills and small-sided games have previously been investigated (17,18), the relationship between the demands of in-season field-based training sessions and competitive match-play remains unclear. Therefore, the aims of the current study were to investigate the running demands of professional soccer players during in-season field-based training sessions and matches, and to examine whether the demands of training are similar to those of competition. It is hypothesised that in-season field-based training sessions will be characterised by greater time spent and distance covered at low speeds, and less at high speeds, than during competitive match-play. While it is expected that the demands of training and matches during the competitive season will be dissimilar, the results of this study have important implications for soccer strength and conditioning staff. This study will detail how the inherent nature of in-season training can affect the training stimulus provided to players,
and highlight the need for comprehensive understanding of this training stimulus in conjunction with weekly match-play.

METHODS

Experimental Approach to the Problem

The physical demands of professional soccer players during in-season field-based training and match-play were assessed during three consecutive seasons between 2007-2010. Data were collected from players contracted to one team competing in the Australian A-League, which is the highest level of professional competition in this country. During the data collection period, the team was participating only in the A-League (i.e. not in the Asian Champions League), and competed approximately once per week. Up to six players per training session, and up to five players per match, were selected for time-motion analysis. In accordance with previous methods (15), the players selected for analysis were rotated, in order to capture data representative of the different positional demands, and limit any bias resulting from individual responses. However, the willingness of some players to participate in the study during training session or matches varied from day-to-day, and the desire of coaches also determined which individuals could be monitored. These factors were out of the control of the research group. As a consequence, the number of individuals analysed in each training session varied, and not all players analysed during training were assessed in games. Time-motion data were used to compare the running demands of field-based players during training and match-play, specifically to quantify whether the low-speed and high-speed running demands previously reported for matches (7,8,28) are simulated during in-season training.
Subjects

Twenty-seven male soccer players (age: 24.9 ± 4.7 yr; body mass: 79.9 ± 7.5 kg; height: 1.82 ± 0.06 m) were recruited from a professional team competing in the Australian A-League. The subject group was comprised of attacking, midfield and defensive players, with goalkeepers being excluded due to their dissimilar positional demands during match-play. For inclusion, subjects were required to be contracted to the applicable Australian A-League team, be willing volunteers, and be injury-free. All subjects were provided with information detailing the purpose and requirements of the study, provided informed consent and were screened for medical contraindications. The study and its methods were approved by the institutional Human Ethics Committee, and supported by the team’s coaching staff.

Procedures

Data were collected across 51 field-based training sessions during the three competitive seasons assessed, resulting in a total of 184 individual training sessions. Training sessions consisted of a warm-up, primary conditioning phase, and cool-down, with all players analysed completing training under the same conditions. Players who did not perform training under the same conditions as their team-mates during a training session (i.e. a restricted workload due to injury) were excluded from the analyses. Training programs were designed entirely by coaching staff to elicit technical, tactical, and physiological responses in the playing group, and varied in accordance with the team’s periodised training plan and residual player fatigue. In an effort to provide an overall reflection of typical in-season field-based training, no discrimination was made between various types of training sessions. As such, a variety of field-based sessions with emphasis on conditioning, technical and tactical development, and recovery, were assessed. In general, players performed 3-5 of these field-based training sessions per week, as well as 1-2 gym-based sessions and 1-2 light recovery sessions (e.g. in a pool). Table 1 describes the typical...
structure of an in-season field-based training session, which was generally 60-90 minutes in duration. Data were also collected across 22 professional matches during the competitive seasons assessed, resulting in a total of 57 individual match files. In accordance with team protocols, players were monitored across the duration of the competitive match. Players who did not complete an entire match due to injury or substitution were excluded from the analysis. In order to allow for comparison between training sessions and competitive matches, the general warm-up and cool-down phases of each data file were not included in the analyses.

***INSERT TABLE 1 ABOUT HERE***

During training sessions and matches, selected players wore a MinimaxX 2.0 GPS device (Firmware v6.59; Catapult Innovations, Scoresby, Australia), sampling at 5 Hertz, fitted in a small pocket of an undergarment located posteriorly between the scapulae. The GPS devices did not delineate forwards, backwards, or lateral directions, and as such, all movement was considered as universal. Average speed (m·min⁻¹) across each training session and match was recorded to quantify external intensity, as per previous methods (33). The total distance (TD) covered in metres was recorded, as was the distance covered and time spent within six discrete locomotor categories; standing (0-0.7 km·h⁻¹), walking (0.7-7.2 km·h⁻¹), jogging (7.2-14.4 km·h⁻¹), running (14.4-19.8 km·h⁻¹), fast running (19.8-25.2 km·h⁻¹) and sprinting (>25.2 km·h⁻¹). The distance covered and time spent within low-speed activity (LSA; <14.4 km·h⁻¹), high-speed running (HSR; >14.4 km·h⁻¹), and very high-speed running (VHSR; >19.8 km·h⁻¹) were also calculated. These locomotor categories are consistent with recent time-motion analysis of soccer (27,28). The number of HSR, VHSR and sprinting efforts were also quantified in accordance with Aughey (3), as two consecutive measurements (i.e. 0.4 s) within the same locomotor category. Individual
players’ data were excluded from the analysis if GPS data were considered erroneous (a horizontal dilution of position greater than five was recorded or the number of satellites available was less than five).

Statistical Analyses
Data were tested for normality using the Kolmogorov-Smirnov test to determine whether parametric or non-parametric statistical methods were appropriate. Field-based training time-motion variables did not follow a normal distribution. Therefore, the non-parametric Mann-Whitney U-test was used to compare the duration and distance covered in discrete locomotor categories, total distance covered, and average speed between training and match-play. As these non-parametric statistical processes determine whether the medians, rather than the means, are different between comparison groups, all data are presented in median and interquartile ranges (2,15,36), and are relative to total training or match duration, in order to allow comparison between the two conditions. The criterion alpha level for significance was set at $p \leq 0.05$. All analyses were performed using SPSS v19.0 (IBM Corporation, Somers, USA).

RESULTS
The median duration of matches and training session differed significantly (5771 s and 4140 s, respectively; $p < 0.001$). Table 2 illustrates the difference in relative time spent and distance covered in locomotor categories during match-play and field-based training sessions. Players were found to spend significantly ($p < 0.001$) more time and cover more distance in the standing category (i.e. moving at $<0.7 \text{ km} \cdot \text{h}^{-1}$) during training when compared to matches. The percentage distance covered walking during match-play and training was not significantly different. However, significantly ($p < 0.001$) more time was spent walking during matches when compared to training. Players were found to spend
more time and cover greater distances in the jogging, running, fast running and sprinting categories during match-play when compared to training. This is highlighted in Figure 1, which represents the relative time spent in LSA, HSR, VHSR, and sprinting. Players spent significantly ($p < 0.001$) more time in high-speed, and less time in low-speed locomotor categories during matches than in training.

***INSERT TABLE 2 NEAR HERE***

***INSERT FIGURE 1 NEAR HERE***

Figure 2 shows the number of efforts per hour of play performed by players in HSR, VHSR, and sprinting. When normalised for duration, significantly ($p < 0.001$) more efforts were recorded across all three high-speed categories during match-play than during training. These efforts are further described in Table 3. The duration spent and distance covered per hour of play in HSR, VHSR, and sprinting were significantly ($p < 0.001$) greater in matches than training, as well as the median effort durations and distances. Median average speed was significantly ($p < 0.001$) greater during match-play ($123.1 \text{ m} \cdot \text{min}^{-1}$) than during training ($68.5 \text{ m} \cdot \text{min}^{-1}$; Figure 3).

***INSERT FIGURE 2 NEAR HERE***

***INSERT TABLE 3 NEAR HERE***

***INSERT FIGURE 3 NEAR HERE***

**DISCUSSION**

Training for team sports such as soccer is designed to simulate the physical, tactical, psychological and skill demands imposed by competitive match-play, in order to prepare athletes for optimal performance (15). This study aimed to quantify the running demands of
professional soccer players during in-season field-based training sessions and match-play, and to examine whether the demands of training are similar to those of competition. In line with the research hypothesis, the major findings of this investigation relate to the dissimilar running demands of match-play and in-season training.

LSA contributed considerably to soccer match-play, with players spending 90.5% of total time in this category (Figure 1). These findings are in agreement with previous time motion analyses of professional soccer players, which have reported 85.4-91.9% of total time spent in LSA (7,8,26,28). Compared to match-play, the current study demonstrated that a significantly greater duration of LSA was observed during in-season field-based training (97.0%; \( p < 0.001 \)). This may be explained by the inherent nature of field-based training, where players often spend extensive periods of a session stationary while listening to coaching instructions, recovering between training activities, and waiting to perform training drills (15). This is represented in the current data by the significantly greater standing duration during training when compared to match-play (48.0% and 2.7%, respectively; \( p < 0.001 \)).

The relative durations of walking and jogging during match-play in the current study (59.7% and 26.1%, respectively) were similar to those previously reported for professional matches (59.3-62.1% and 26.1-28.4%, respectively) (7,8,28). However, the relative durations of walking and jogging during training (34.0% and 13.0%, respectively) were significantly lower (\( p < 0.001 \); Table 2), when compared to match data from the current research. In agreement with Dawson et al. (11), these findings suggest that team sport athletes sacrifice non-standing LSA in preference of standing during field-based training. These data also indicate that training sessions commonly utilise periods of passive recovery (i.e. standing) between bouts of high-intensity activity, whereas players engage in extended periods of active recovery (i.e. walking and jogging) during a match. Thus, results from the current study reflect the inherent differences between field-based training and
competitive matches. While players are able to recover passively between drills and small-sided games during training, they are required to continue working at a higher intensity during match-play, possibly to maintain position between game involvements and to track opposition players.

An interesting finding in the current investigation was that the relative distance covered by jogging did not differ between training and matches (Table 2). During training, players completed the same relative distance jogging as in match-play, but did so in less time. It is possible that players completed jogging activities within the higher range of the respective categories during training, and the lower range during matches. As will be discussed in more detail later, this may be related to the strong emphasis on small-sided games and drills in restricted areas during in-season training, where players might not have adequate space to reach criterion velocities for higher locomotor categories. Future research should therefore investigate the discrepancies between the duration spent and distance covered by jogging activities.

The current findings for LSA highlight the dissimilar demands of match-play and training, which may be related to the goals of the in-season training plan. In accordance with typical team sport periodisation practices, the objective of in-season training is to balance training load with recovery in order to limit player fatigue (9,21,23). To facilitate recovery from frequent match-play, and ensure excessive physical and psychological strain is avoided, coaches typically do not impose heavy training stimuli upon players in the days immediately prior to or following competitive match-play (20). Previous research has shown that soccer players who exhibit symptoms of overreaching, will also experience reductions in sprint velocity, vertical jump height and leg strength (22). As such, overreaching and overtraining will inhibit a player’s ability to train and compete in match-play effectively. As the current investigation reports on the competition phase of the
periodised training plan, which typically involves reduced training loads and intensity (9), large volumes of low-intensity activity are to be expected during training.

Nonetheless, to facilitate maintenance of physical and physiological capacities during the competition phase, sufficient training stimulus must be employed to prevent detraining. Previous research has established that short-duration, high-intensity movements such as sprints, tackling, jumping and changes of direction, are critical to performance in soccer (6,26). In-season soccer training sessions should therefore include sufficient high-intensity stimulus to facilitate maintenance of match performance. In the current investigation, HSR during match-play was found to account for 9.2% of duration and 21.6% of distance, which is similar to previously reported values (7,8,26,28). However, significantly less time was spent and distance covered in HSR during field-based training (3.0 and 12.8%, respectively; \( p < 0.001 \)). The number of HSR efforts during training, as well as the median duration and distance of each effort, was also significantly lower than for match-play (\( p < 0.001 \)). Similar trends were evident across VHSR and sprinting data (Table 3). Additionally, average speed during match-play was significantly higher than during field-based training in the current study (Figure 3; \( p < 0.001 \)).

The difference observed in high-speed activities between training and match-play has implications for in-season soccer conditioning and competition performance, in that repeated sprint ability is a critical aspect of soccer (34). Results of the current investigation suggest that per hour of play, the distance covered and time spent sprinting were significantly lower during training than for match-play (\( p < 0.001 \); Table 3). The number of sprinting efforts per hour of play during training (\( n = 2.1 \)) was also significantly less than during match-play (\( n = 8.3; p < 0.001 \)). Although it is difficult to assess from the current data whether this low sprinting volume during in-season training was effective in maintaining repeated sprint ability, it is possible that it may be insufficient to elicit beneficial adaptations (15). As the ability to perform the physical and cognitive skills
required during team sports is most impacted by high-intensity periods that induce fatigue (13,32), training outcomes could benefit from having these demands simulated during field-based training sessions (15).

Nonetheless, based on the current data, it was not possible to calculate the weekly load associated with field-based training, and examine whether this was sufficient in maintaining high-speed running performance across the season. Indeed, when considering the training effect associated with the high-intensity efforts completed during weekly match-play, the low volume of HSR and sprinting during in-season field-based training may provide adequate stimulus for the maintenance of repeated sprint ability. As maintenance of physiological capacities is often the focus of in-season training for team sports (21), this finding may be indicative of the periodised team training plan. Further research is required to fully elucidate whether the decreased HSR and sprinting demands of in-season field-based training are sufficient for the maintenance of anaerobic capacity and repeated sprint ability. Such research should aim to examine the entire weekly training dose imposed on players, including that experienced during matches, and how this relates to the maintenance of HSR performance across a season.

The disparity between HSR activities during training and match-play may also be explained by the strong emphasis on small-sided games and drills in small areas during training (Table 1). These drills are widely used by soccer players and coaches as they are recognised to elicit physiological, technical and tactical development (12,24,29). Generally, small-sided games take place using reduced pitch dimensions (19,29). However, due to the decreased pitch dimensions, players may not have the space required to reach the criterion velocity to register a HSR, VHSR or sprinting effort, despite accelerating maximally. Furthermore, the duration and distance of each individual HSR and VHSR effort are likely to be limited by reduced pitch dimensions. As such, the inherent design of training drills commonly used for soccer may in fact decrease the exposure of players to high-speed
activities during field-based training sessions. Although an analysis of type and structure of SSG and drills in small areas was beyond the scope of this investigation, future research could examine how the inherent design of these games and drills can affect the in-season training load of soccer players.

While the current study contributes to the limited understanding of the physical demands of professional soccer players during in-season field-based training, and how these demands relate to those of match-play, it is important to note that this research was limited by the amount of full data sets for individual players. Furthermore, not all players analysed during training could be assessed during games, in accordance with the coach’s wishes and the willingness of individual players to wear a GPS device during a competitive match. As a consequence, the findings of this study may be limited in that the relationships between the demands of individual players during training and matches could not be quantified. In addition, the position-specific physical demands were unable to be described. Previous research has identified positional differences to exist in the running demands of defenders, midfielders and forwards during soccer match-play (7,8,26,28). Future research should examine whether similar differences exist during field-based training. Additionally, it should be acknowledged that not all training sessions during the three competitive seasons assessed could be monitored, due to team travel, training schedules, and availability of equipment. As such, a range of conditioning, technical and tactical, and recovery sessions were assessed. While it is possible that the disconnect in running demands found between training sessions and matches may be due to the structure and intensity of individual training sessions, no discrimination was made between various types of training sessions in order to provide an overall reflection of typical in-season field-based training. As such, while more specific analyses were not possible, the current results provide valuable information for coaches relating to the typical demands of field-based training sessions and matches.
It should also be acknowledged that the time-motion analyses undertaken in the current study did not extend to assessment of skilled movements such as ball involvements, tackles and jumping efforts. Future research could aim to analyse the skilled movement patterns during field-based training to advance the understanding of physical exertion during training. Due to the non-normal distribution of our data, results are presented as median and interquartile ranges. While this makes it difficult to compare directly with previous research that has reported means and standard deviations, the relationship between our findings and those of previous research are still useful when these differences in the representation of data are acknowledged.

**PRACTICAL APPLICATIONS**

The results of the current study provide beneficial information for soccer coaches and strength and conditioning staff, detailing the dissimilar running demands of in-season field-based training and match-play for professional soccer players. From the current data, in-season field-based training sessions do not appear to simulate the high-intensity running demands of professional soccer match-play. This is likely to be a function of increased focus on low-intensity recovery practices between competitive matches, and might also reflect the inherent nature of small-sided games and drills in restricted areas. Nonetheless, it is important to also consider the high-intensity training dose associated with weekly match-play and whether this is sufficient to maintain physical performance throughout the competitive season. The practical application of this study emphasises the importance for strength and conditioning staff to monitor whether in-season field-based training is effective in facilitating the desired training responses. Vigilant monitoring processes will provide strength and conditioning staff with information to assess not only whether the training dose being applied to players is appropriate to the goals of their current training phase, but also whether these practices are able to facilitate meaningful improvements or
maintenance in performance. Furthermore, to provide a comprehensive understanding of the global training stimulus, it is important that coaches monitor the training load associated with all field-based training session across a week, in concert with other training practices (i.e. pool based recovery or gym-based conditioning) and the training dose imposed by competitive matches. Future research should aim to examine this global training stimulus and assess whether it is appropriate in facilitating maintenance or gains in performance. Further research could also assess high-intensity performance during match-play across the competitive season, and determine whether current training practices are appropriate for maintaining match performance within various playing positions.

ACKNOWLEDGEMENTS

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**Table 1.** Structure of a typical in-season field-based training session for professional soccer.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration (min)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>General warm-up</td>
<td>5-10</td>
<td>Slow jog and static/dynamic stretches</td>
</tr>
<tr>
<td>Specific warm-up</td>
<td>10-15</td>
<td>Shuttle runs, short passing drills and dribbling drills</td>
</tr>
<tr>
<td>Technical development</td>
<td>10-15</td>
<td>Longer passing/shooting drills and agility runs</td>
</tr>
<tr>
<td>Tactical/technical development</td>
<td>30-45</td>
<td>Small-sided games (5 v 5/4 v 4), full field simulation and set play practice</td>
</tr>
<tr>
<td>Cool down</td>
<td>3-5</td>
<td>Walk, static/dynamic stretching and core strengthening</td>
</tr>
</tbody>
</table>
Table 2. Relative duration spent and distance covered in locomotor categories during training and match-play.†

<table>
<thead>
<tr>
<th></th>
<th>Match-play</th>
<th></th>
<th>Training</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Duration</td>
<td>% Distance</td>
<td>% Duration</td>
<td>% Distance</td>
</tr>
<tr>
<td>Standing (&lt;0.07 km·h⁻¹)</td>
<td>2.7 (2.7)</td>
<td>0.1 (0.1)</td>
<td>48.0 (14.0)*</td>
<td>9.6 (4.5)*</td>
</tr>
<tr>
<td>Walking (0.7-7.2 km·h⁻¹)</td>
<td>59.7 (7.1)</td>
<td>41.7 (9.1)</td>
<td>34.0 (9.0)*</td>
<td>42.6 (7.5)*</td>
</tr>
<tr>
<td>Jogging (7.2-14.4 km·h⁻¹)</td>
<td>26.1 (6.7)</td>
<td>36.5 (5.6)</td>
<td>13.0 (4.0)*</td>
<td>34.1 (6.3)</td>
</tr>
<tr>
<td>Running (14.4-19.8 km·h⁻¹)</td>
<td>6.4 (3.1)</td>
<td>13.9 (4.6)</td>
<td>2.0 (1.0)*</td>
<td>9.3 (3.5)*</td>
</tr>
<tr>
<td>Fast running (19.8-25.2 km·h⁻¹)</td>
<td>1.9 (0.9)</td>
<td>5.5 (2.4)</td>
<td>1.0 (1.0)*</td>
<td>2.7 (2.4)*</td>
</tr>
<tr>
<td>Sprinting (&gt;25.2 km·h⁻¹)</td>
<td>0.5 (0.3)</td>
<td>1.6 (1.1)</td>
<td>0.0 (0.0)*</td>
<td>0.5 (0.8)*</td>
</tr>
</tbody>
</table>

†Data are median and interquartile range.

*Significantly different from match-play (p < 0.001).
Table 3. High-speed running, very high-speed running and sprinting data during training sessions and match-play.†

<table>
<thead>
<tr>
<th></th>
<th>Match-play</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HSR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration/hour (s)</td>
<td>331.2 (132.3)</td>
<td>123.0 (110.75)*</td>
</tr>
<tr>
<td>Mean effort duration (s)</td>
<td>2.3 (0.3)</td>
<td>1.7 (0.7)*</td>
</tr>
<tr>
<td>Distance/hour (m)</td>
<td>1634.4 (575.3)</td>
<td>517.2 (314.5)*</td>
</tr>
<tr>
<td>Mean effort distance (m)</td>
<td>13.0 (1.7)</td>
<td>10.0 (3.3)*</td>
</tr>
<tr>
<td><strong>VHSR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration/hour (s)</td>
<td>85.1 (39.3)</td>
<td>28.5 (40.79)*</td>
</tr>
<tr>
<td>Mean effort duration (s)</td>
<td>2.0 (0.0)</td>
<td>1.5 (1.0)*</td>
</tr>
<tr>
<td>Distance/hour (m)</td>
<td>524.1 (251.3)</td>
<td>132.8 (143.4)*</td>
</tr>
<tr>
<td>Mean effort distance (m)</td>
<td>13.0 (2.3)</td>
<td>8.0 (0.7)*</td>
</tr>
<tr>
<td><strong>Sprinting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration/hour (s)</td>
<td>16.9 (10.6)</td>
<td>4.6 (8.5)*</td>
</tr>
<tr>
<td>Mean effort duration (s)</td>
<td>2.0 (0.0)</td>
<td>1.0 (1.0)*</td>
</tr>
<tr>
<td>Distance/hour (m)</td>
<td>120.3 (85.2)</td>
<td>21.1 (34.4)*</td>
</tr>
<tr>
<td>Mean effort distance (m)</td>
<td>14.0 (4.0)</td>
<td>6.0 (3.0)*</td>
</tr>
</tbody>
</table>

HSR = high-speed running; VHSR = very high-speed running.

†Data are median and interquartile range.

*Significantly different from match-play (p < 0.001).
Figure 1. Relative duration of low-speed activity (LSA), high-speed running (HSR), very high-speed running (VHSR) and sprinting during professional soccer match-play and in-season field-based training. Data are median and distribution of scores.

*Significantly different from match ($p < 0.001$).
Figure 2. Number of efforts per hour in high-speed running (HSR), very high-speed running (VHSR) and sprinting categories during professional soccer match-play and in-season field-based training. Data are median and distribution of scores.

*Significantly different from match ($p < 0.001$).
Figure 3. Average speed (m·min⁻¹) during professional soccer match-play and in-season field-based training. Data are median and distribution of the scores.

*Significantly different ($p < 0.001$).