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Determination of the Relative Profile of Velocity and Acceleration in Semi-Professional Soccer Players: A Cross-Sectional Study

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Abstract: The velocity and acceleration of a soccer player varies depending on the specific demands of the field position as well as individual characteristics, establishing the need to determine relative profiles by position. A cross-sectional study was conducted in 18 semi-professional soccer players to determine (i) the specific demands of external load according to playing position, (ii) distances covered at different intensities and the number of sprints, and (iii) the number of accelerations at moderate and high intensity. GPS tracking systems were used to collect data, and the relative acceleration profiles were analyzed based on initial velocity (0–7 km/h; 7.1–14.3 km/h; >14.3 km/h), intensity (moderate 50–75% and high > 75% of maximal acceleration), number of sprints/accelerations, and distance covered. Additionally, relative speed profiles were evaluated through the distance covered at moderate intensity (40–60% Vmax), high intensity (60–75.5% Vmax), very high intensity (>75.5% Vmax), total distance, and number of sprints. Statistically significant differences were observed in the distance covered at moderate and high intensity (midfielders), distance covered sprinting (center backs), and acceleration at moderate and high intensity in all positions ($p < 0.05$). These findings will enhance the monitoring of external loading strategies and prescription of specific training exercises for soccer players based on their respective playing position, ultimately contributing to optimized performance.

Keywords: acceleration profile; football; GPS technology; running speed; starting speed; soccer playing positions

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1. Introduction

From a physical demand perspective, soccer is mainly an intermittent aerobic sport, where players alternate between multidirectional high-intensity efforts and numerous low-intensity rest periods [1–3]. It is increasingly important to monitor team sport athletes to understand individual responses to load [4]. Global Positioning System (GPS) devices offer the possibility to objectively measure a wide range of variables, allowing us to understand the conditioning demands of players according to their playing position during training sessions or competitions [1,5–7].

In the updated model of injury etiology, training and match loads contribute alongside intrinsic and extrinsic factors to the multifactorial model of injury etiology [8]. It has been shown that training load is a modifiable risk factor for overuse injuries [9]. This information becomes even more relevant knowing that overuse injuries, which predominate in soccer, are often a mistake in the perception and programming of the external training load [10]. In a recent study, Perez et al. demonstrated the impact of weekly training external load and matches as a risk factor in overuse muscle injuries. Current data suggest that a combination of a heavy external training load week and a short period of high-intensity running during a match might be related to an increased risk of muscle injuries in professional soccer players [1–11]. Like the role of training load, playing position might also substantially influence soccer player's injury rate [12].

While activity profiles have been widely researched, a common methodological limitation is the exclusive use of absolute values; recent findings suggest that each player's demands should be considered individually [13]. Indeed, player activity is usually classified into different intensity or speed zones, but there are no standardized zones. The lack of a universal definition leads to confusion about speed level thresholds, which can lead to erroneous conclusions based on a fixed threshold [14,15]. Using a fixed threshold determines absolute speed ranges, i.e., arbitrary speed zones independent of the physical conditioning levels of the players, such as the distance covered at high intensity (>19.8 km/h) or sprinting (>25.2 km/h) [7,16–18]. Absolute ranges seem to be commonly adopted in soccer; however, the interpretation of arbitrary speed zones has the disadvantage of masking individual capabilities [5,19,20]. Meanwhile, an individualized threshold based on the player's maximum speed (Vmax) allows for accounting for these individual capabilities [5,14]. To define intensity zones, the most used thresholds are moderate (between 40 and 60% of Vmax), high (60–75% of Vmax), and very high or sprint (>75% of Vmax) [13,21,22].

Analyzing specific demands, several studies have pointed out that indicators based solely on the speed profile do not reveal the full picture of the load, because efforts with high accelerations require more energy and a higher muscle demand than speed efforts [23]. Incorporating accelerometry through GPS calculation factors into the workload has highlighted a 6 to 8% difference in load estimation, compared to monitoring techniques derived solely from speed calculated by positioning systems (e.g., GPS) [16,23–27]. Furthermore, players rarely have the time and space to reach maximum speeds, relying instead on their ability to accelerate rapidly [19,28,29]. Similar to speed profiles, acceleration profiles can be quantified in absolute or relative terms to determine action intensity. Common thresholds in the literature for low, moderate, and high-intensity actions are less than 2 m/s^{-2}, 2–3 m/s^{-2}, and greater than 3 m/s^{-2} for absolute thresholds, and less than 50%, 50–75%, and more than 75% of maximal acceleration for relative thresholds [16,30–34].

Therefore, the relative method may offer a better estimation of acceleration levels and physical load [35]. Additionally, the percentage of acceleration allows for determining intensity thresholds specific to an individual player or playing position, avoiding generic values for all players [16,35]. Similarly, the use of absolute thresholds for the speed profile could underestimate the intensity of actions for slower players and overestimate it for faster players during matches [13,22,36,37]. In conclusion, employing an individualized threshold offers the opportunity to assess the specific demands of each player, reducing errors in quantifying physical performance at different intensities [5,14].

When quantifying the external load from the acceleration profile, it should be considered that the ability to accelerate largely depends on the initial speed (V0) of the player, with a correlation coefficient of 0.98 between both variables [16]. Each player's maximum possible acceleration progressively decreases as the initial running speed increases [31,38], and most efforts with high accelerations reach low or moderate maximum speeds [16]. A common mistake is to qualify an acceleration of low or high intensity by referring to an absolute numerical value, without considering the initial speed [31,39]. Therefore, regardless of the chosen threshold, the intensity of accelerations should be classified based on the initial speed into three sections: walking (0–7 km/h), jogging (7.1–14.3 km/h), and running (>14.4 km/h) [16,31,35].

Considering the different tactical roles of different playing positions in soccer matches, recent studies confirm that total distance traveled, maximum speed, high-intensity distance, average speed, sprint distance, and the number of accelerations are related to the playing position [40–43]. Therefore, just like the quantification method, the playing position might influence the external load of soccer players [38,44]. This could explain the variability in the speed and acceleration profile based on playing position [45]. Therefore, the main goal of this study was to determine the relative profile based on speed and acceleration in semi-professional soccer players according to their playing position.

2. Materials and Methods

2.1. Study Design

A cross-sectional study was carried out based on the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement [46]. The Helsinki declaration and all human experimentation rules were considered [47], and the research was reviewed and approved by an ethical committee (CIPI/18/195). All participants were previously informed before their inclusion in the study, and a written consent form was obtained from each participant.

The objectives of the study were as follows. A non-experimental design was used in which no situation was constructed, but rather, existing situations performed by the players in training sessions and matches were observed through the coaching staff's preparation. An intrasubject observational design was used, monitoring training and competition sessions through the previously mentioned GPS system.

2.2. Participants

The participants in this study were semi-professional soccer players from the Spanish Second Division B National League Championship (age: 26.93 ± 3.88 years; body height: 179.66 ± 1.64 cm; body mass: 73.51 ± 4.63 kg; values are presented as mean ± SD), and they were analyzed and categorized according to five positions: central defenders (CDs), fullbacks (FBs), central midfielders (MFs), wide midfielders (WMFs), and forwards (FWs).

Seventeen semi-professional soccer players were analyzed during the last 14 matchdays of the Spanish Second Division B League Championship of the 2018–2019 season (weekdays 25–38). The team typically conducted five weekly training sessions and one match per week, with a total of 823 sessions recorded, including both training and match sessions. The external load was recorded on a weekly basis for each player individually, providing a detailed account of the workload experienced by each athlete.

Of the records obtained in the training sessions, only the field sessions were considered, discarding the sessions performed in the gym or post-match recovery sessions. No individual readaptation or physical conditioning sessions were included for the analysis [23]. In addition, the sessions of the first week of incorporation of the injured players were excluded from the analysis to avoid greater variability in the results [48]. Regarding the data corresponding to competitive matches, players who were part of the starting eleven and played for the entire duration of the match were considered. Substituted players and non-starting players were not analyzed [17,44,49–52]. Similarly, players who did not complete a minimum of 25 sessions were not included [41,49]. Finally, only field players' records were considered, excluding records corresponding to goalkeepers [7].

2.3. Measurement System

Data on the running performance of the players were collected by GPS technology (GPSports SPI Pro-X, Camberra, Australia; triaxial accelerometer sampling 6 g at 100 Hz integrated; size = 48 × 20 × 87 mm; mass = 76 g) with a sampling frequency of 15 Hz. It has been previously demonstrated that this type of system provides valid and reliable estimates. However, to avoid inter-unit errors, players used the same GPS unit throughout the experimental period, thereby excluding variability between units [53,54].

2.4. Measurement Methods

The variables included the following: total distance (m); distance in three speed categories (running (40–60% Vmax), high-speed running (60–75.5% Vmax), and very-high-speed running (>75.5% Vmax)); number of high-intensity and very-high-intensity sprints; number and distance of moderate-intensity accelerations (50–75% of maximal acceleration);

number and distance of high-intensity accelerations (>75% of maximal acceleration) according to three sections of initial speed (walking (<7 km/h), jogging (7.1–14.3 km/h), and running (>14.3 km/h)).

2.5. Statistical Analysis

The statistical analysis began with the import of the data from the recording devices into a database created ad hoc with the spreadsheet processing program Microsoft Excel v. 2016 (Microsoft Corp., Redmond, WA, USA). For subsequent data analysis, the SPSS v. 22.0 statistical software package (IBM Corp., Armonk, WA, USA) was used, with statistical significance set at $p < 0.05$. Firstly, the normal distribution of the variables was analyzed using the Kruskal–Wallis test and displaying box plots for the identification and elimination of extreme outliers. For the description of the quantitative variables in relation to the individual characteristics of the participants, the maximum values of velocity and acceleration as a function of the initial velocity and the mean and standard deviation were used for normal distributions (parametric) and the median and interquartile range for non-normal distributions (non-parametric). For the analysis of the differences in relation to the velocity and acceleration profile according to the position of the player, in those cases of non-normal distributions of a given variable, a logarithmic transformation of the data was performed for its treatment [55]. In the case of data transformation, the descriptive statistics presented are those computed once the inverse logarithmic transformation was performed [56]. One-way analysis of variance (ANOVA) was used in the assumptions of normality, using the Kruskal–Wallis test in the assumptions of non-normality, to study the differences between maximum speeds, maximum accelerations, and distances run at different intensities, as a function of the player's position. Homogeneity of variances was examined with Levene's test, considering Welch's adjustment for rectification of the *F*-statistic if necessary [57]. Due to the difference in group size by position, the Scheffé test was employed for post hoc comparisons in case of statistically significant differences, considering the Games–Howell test for cases of rectification of the *F*-statistic [58]. The effect size measure was examined using partial eta squared values (η_p^2), basing its interpretation on the following criterion: 0.01–0.05, small effect; 0.06–0.13, medium effect; >0.13, large effect [59]. For all analyses, 95% confidence intervals for the mean (95% CI) are presented.

3. Results

3.1. Maximum Velocity and Maximum Accelerations Based on Initial Velocity According to Player Position

No statistically significant differences ($p > 0.05$) were observed with respect to field position and the variables of maximum speed ($F(4;12) = 0.836$; $p > 0.05$; $\eta_p^2 = 0.21$), maximum acceleration with an initial speed of 0–7 km/h ($F(4;12) = 0.287$; $p > 0.05$; $\eta_p^2 = 0.08$), maximum acceleration with an initial speed of 7–14.3 km/h ($F(4;12) = 0.053$; $p > 0.05$; $\eta_p^2 = 0.02$), and maximum acceleration with an initial speed > 14.3 km/h ($F(4;12) = 0.302$; $p > 0.05$; $\eta_p^2 = 0.09$). Refer to Table 1 for a comparison of maximum speed and acceleration based on playing position (Table 1).

Table 1. Maximum velocity and maximum acceleration based on initial velocity according to player position.

	Total (n = 17)	Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)
Vmax (km/h)	32.2 ± 1.7 (29.0–34.5)	31.6 ± 2.1 (29.0–34.0)	33.3 ± 0.7 (32.7–34.1)	31.5 ± 1.5 (30.2–33.3)	32.8 ± 2.3 (30.2–34.5)	32.6 ± 1.0 (31.8–33.3)
ACCmax (m/s^{-2}) Vini 0–7 km/h	6.3 ± 0.4 (5.6–7.1)	6.2 ± 0.7 (5.7–7.1)	6.4 ± 0.3 (6.2–6.7)	6.2 ± 0.4 (5.6–6.6)	6.5 ± 0.6 (5.8–6.9)	6.5 ± 0.1 (6.4–6.6)

Table 1. *Cont.*

	Total (n = 17)	Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)
ACCmax (m/s^{-2}) Vini 7–14.3 km/h	5.0 ± 0.4 (4.1–5.9)	5.0 ± 0.6 (4.5–5.8)	5.0 ± 0.1 (4.9–5.1)	4.9 ± 0.4 (4.5–5.4)	5.0 ± 0.9 (4.1–5.9)	5.00 ±0.1 (4.9–5.1)
ACCmax (m/s^{-2}) Vini > 14.3 km/h	3.7 ± 0.5 (3.0–4.8)	3.5 ± 0.6 (3.0–4.3)	3.8 ± 0.2 (3.6–4.1)	3.6 ± 0.3 (3.4–4.1)	3.8 ± 0.8 (3.1–4.8)	3.7 ± 0.2 (3.6–3.9)

Abbreviations: ACCmax, maximum acceleration; m/s^{-2}, meters per second squared; km/h, kilometers per hour; Vini, initial velocity; Vmax, maximum velocity.

3.2. Distances Covered According to Intensity and Playing Position

Regarding the total distance covered, statistically significant differences were determined considering the field position (F(4;752) = 10.471; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.053$). Specifically, post hoc analysis showed that midfielders covered a significantly greater distance compared to center backs ($p < 0.05$), lateral backs ($p < 0.001$), and forwards ($p < 0.001$).

Regarding the distances covered at moderate intensity, the results showed statistically significant differences between the different positions (F(4;320.316) = 17.407; $p < 0.001$) with a mean effect size of $\eta_p^2 = 0.093$. In particular, post hoc analysis revealed that midfielders covered significantly greater distances at moderate intensity than those covered by players in all other positions ($p < 0.001$ for all comparisons). Likewise, lateral midfielders covered significantly greater distances at moderate intensity compared to lateral defenders ($p < 0.001$).

Regarding the distance covered at high intensity, the results showed statistically significant differences between the different positions (F(4;750) = 4.339; $p < 0.01$) with a small effect size ($\eta_p^2 = 0.023$), showing an increase in the distance covered between midfielders compared to fullbacks ($p < 0.05$).

Regarding the distances covered in sprinting, the results showed statistically significant differences between the different positions (F(4;662) = 2.629; $p < 0.05$) with a small effect size ($\eta_p^2 = 0.016$). In particular, post hoc analysis showed that central defenders covered a significantly greater distance in sprinting than midfielders ($p < 0.05$) (Table 2).

Table 2. Distances covered according to intensity and playing position. Distance covered is expressed as a percentage of the total distance in the three analyzed zones according to the playing position.

Distance Covered (m)	Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)	One-Way ANOVA (F/Df; *p*-Value) (η_p^2)
Total	5199.9 ^{c} (4934.10; 5482.76)	4988.8 ^{c} (4819.47; 5176.06)	5834.4 ^{abe} (5623.41; 6053.40)	5432.5 (5188.00; 5675.44)	5046.6 ^{c} (4775.29; 5321.08)	(F(4;752) = 10.471; $p < 0.001$) ($\eta_p^2 = 0.053$)
Moderate intensity	822.0 ^{c} (80.5%) (758.9; 890.2)	731.9 ^{cd} (80.6%) (691.37; 774.46)	1065.3 ^{abde} (82.6%) (989.69; 1146.56)	856.0 ^{bc} (79.4%) (794.51; 922.35)	738.2 ^{c} (79.0%) (667.57; 816.39)	(F(4;320.316) = 17.407; $p < 0.001$) ($\eta_p^2 = 0.093$)
High intensity	156,0 (15.3%) (134.8; 180.7)	141.7 ^{c} (15.5%) (137.08; 167.88)	196.3 ^{b} (15.2%) (176.60; 217.77)	193.1 (17.9%) (169.82; 219.28)	162.1 (17.4%) (139.31; 188.79)	(F(4;750) = 4.339; $p < 0.01$) ($\eta_p^2 = 0.023$)
Sprint	42.7 ^{c} (4.1%) (34.0; 53.5)	36.4 (3.9%) (31.0; 42.8)	28.5 ^{a} (2.2%) (24.2; 33.6)	29.7 (2.6%) (24.4; 36.2)	32.9 (3.5%) (25.8; 41.8)	(F(4;662) = 2.629; $p < 0.05$) ($\eta_p^2 = 0.016$)

Table 2. *Cont.*

Distance Covered (m)	Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)	One-Way ANOVA (F/Df; *p*-Value) (η_p^2)
Number of sprints	17.5 (15.8; 19.1)	15.1 [c] (14.0; 16.1)	20.1 [be] (18.7; 21.5)	17.5 (16.1; 19.0)	14.6 [c] (13.3; 16.0)	(F(4;327.186) = 10.747; $p < 0.001$) ($\eta_p^2 = 0.056$)

[a] Significant difference with CD; [b] significant difference with FB; [c] significant difference with MF; [d] significant difference with WMF; [e] significant difference with FW.

3.3. Number of High-Intensity Sprints According to Player Position

Regarding the number of sprints performed in zone 5, the results showed statistically significant differences between the different positions (F(4;327.186) = 10.747; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.056$). Specifically, post hoc analysis showed that midfielders performed significantly more zone 5 sprints than lateral backs and forwards ($p < 0.001$ for both comparisons). Regarding the number of sprints in zone 6, the results showed no significant differences (F(4;752) = 2.045; $p > 0.05$; $\eta_p^2 = 0.011$) (Table 2).

3.4. Distances Covered in Acceleration Efforts of Moderate Intensity

Regarding the total distances covered in ACC 50–75% acceleration efforts, the results showed statistically significant differences between the different player positions (F(4;429.58) = 3.073; $p < 0.05$) with a small effect size ($\eta_p^2 = 0.013$). In particular, post hoc analysis showed that lateral midfielders covered a significantly greater total distance than lateral defenders ($p < 0.05$).

Distances covered in ACC 50–75% acceleration efforts depend on the initial speed; the results showed statistically significant differences in the distances covered between the different positions for accelerations with an initial speed of 0–7 km/h (F(4;317.720) = 16.546; $p < 0.001$) with a mean effect size of $\eta_p^2 = 0.090$. Specifically, post hoc analysis showed that central defenders traveled significantly greater distances than players in all other positions ($p < 0.001$ for all comparisons). Likewise, significant differences were found between the distances covered between lateral midfielders and midfielders with lateral defenders, which were significantly greater than the distances covered by lateral defenders in both cases ($p < 0.05$ for both comparisons).

For initial speeds of 7.1–14.3 km/h, the results showed statistically significant differences in the distances covered between the different positions at ACC acceleration efforts 50–75% (F(4;325.743) = 6.726; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.038$). Specifically, post hoc analysis showed that midfielders, lateral midfielders, and forwards all covered significantly greater distances than lateral defenders ($p < 0.001$ for the comparisons with midfielders and lateral midfielders; $p < 0.05$ for the comparison with forwards).

Finally, for acceleration efforts ACC 50–75% and initial speed > 14.3 km/h, the results showed statistically significant differences in the distances traveled between the different positions (F(4;299.988) = 6.858; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.032$). In particular, post hoc analysis showed that central defenders and lateral midfielders covered significantly greater distances than midfielders ($p < 0.001$ for both comparisons) (Table 3).

3.5. Distances Covered in Acceleration Efforts of High Intensity

Regarding the total distances covered in ACC acceleration efforts > 75%, the results showed statistically significant differences in the distances covered between the different positions (F(4;567) = 5.787; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.039$). In particular, post hoc analysis showed that central defenders traveled a significantly greater total distance than fullbacks and midfielders ($p < 0.01$ for both comparisons).

Table 3. Distances covered in acceleration efforts of moderate and high intensity.

Variables		Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)	One-Way ANOVA (F/Df; *p*-Value) (η_p^2)
Moderate intensity 50–75% ACCmax	Total	108.10 (92.70; 123.51)	100.06 [d] (90.04; 110.08)	115.06 (104.48; 125.64)	132.07 [b] (114.81; 149.32)	119.20 (104.98; 133.42)	(F(4;429.958) = 3.073; $p < 0.05$) ($\eta_p^2 = 0.013$)
	Vini 0–7 km/h	65.28 [bcde] (59.75; 70.82)	41.19 [acd] (38.26; 44.13)	48.40 [ab] (45.14; 51.65)	50.15 [ab] (44.86; 55.45)	42.19 [a] (38.53; 45.85)	F(4;317.720) = 16.546; $p < 0.001$) ($\eta_p^2 = 0.090$)
	Vini 7–14.3 km/h	65.25 (60.01; 70.50)	56.51 [cde] (51.85; 61.17)	71.01 [b] (65.93; 76.09)	78.31 [b] (68.55; 88.06)	69.03 [b] (62.94; 75.12)	(F(4;325.743) = 6.726; $p < 0.001$) ($\eta_p^2 = 0.038$)
	Vini >14.3 km/h	44.73 [c] (39.10; 50.35)	36.32 (32.95; 39.69)	31.49 [ad] (28.69; 34.28)	42.70 [c] (37.75; 47.65)	38.26 (33.67; 42.85)	(F(4;299.988) = 6.858; $p < 0.001$) ($\eta_p^2 = 0.032$)
High intensity >75% ACCmax	Total	13.79 [bc] (11.65; 16.65)	8.65 [a] (7.74; 9.65)	8.64 [a] (7.68; 9.71)	10.56 (9.01; 12.33)	10.16 (9.08; 12.18)	(F(4;567) = 5.787; $p < 0.001$) ($\eta_p^2 = 0.039$)
	Vini 0–7 km/h	3.88 (3.28; 4.57)	3.72 (3.31; 4.16)	4.00 (3.60; 4.43)	3.73 (3.29; 4.19)	3.58 (3.03; 4.19)	NS
	Vini 7–14.3 km/h	7.22 [b] (6.12; 8.48)	5.35 [ad] (4.78; 5.96)	5.85 (5.25; 6.51)	7.45 [b] (6.56; 8.44)	7.21 (6.23; 7.31)	(F(4;152.799) = 4.890; $p < 0.001$) ($\eta_p^2 = 0.048$)
	Vini >14.3 km/h	8.28 (7.14; 9.58)	7.20 (6.14; 7.48)	7.05 (7.37; 8.80)	7.73 (6.81; 8.76)	8.88 (7.30; 10.76)	NS

Abbreviations: ACCmax, maximum acceleration; m/s^{-2}, meters per second squared; km/h, kilometers per hour; NS, not significant; Vini, initial velocity. [a] Significant difference with CD; [b] significant difference with FB; [c] significant difference with MF; [d] significant difference with WMF; [e] significant difference with FW.

The results showed no statistically significant differences in the distances traveled between the different positions for accelerations with an initial speed of 0–7 km/h (F(4;376) = 0.446; $p > 0.05$; $\eta_p^2 = 0.005$). With respect to ACC acceleration efforts > 75% and initial speeds of 7.1–14.3 km/h, the results showed statistically significant differences in the distances traveled between the different positions (F(4;152.799) = 4.890; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.048$). Specifically, post hoc analysis showed that central defenders and lateral midfielders traveled a significantly greater distance than lateral defenders ($p < 0.05$ and $p < 0.01$, respectively). Finally, for ACC acceleration efforts > 75% and initial speeds > 14.3 km/h, the results showed no statistically significant differences in the distances covered between the different positions (F(4;131.893) = 2.552; $p > 0.05$; $\eta_p^2 = 0.035$) (Table 3).

3.6. Number of Accelerations According to Playing Position

Regarding the number of accelerations performed in ACC 50–75% acceleration efforts with an initial speed of 0–7 km/h, the results showed statistically significant differences between the different positions (F(4;318.822) = 21.267; $p < 0.001$) with a mean effect size of $\eta_p^2 = 0.107$. In particular, post hoc analysis showed that central defenders performed a significantly higher number of accelerations of these characteristics than players in the other positions ($p < 0.001$ for all comparisons). Likewise, the results showed a significantly lower number of these accelerations in lateral defenders compared to midfielders and lateral midfielders ($p < 0.001$ and $p < 0.05$, respectively). For their part, midfielders performed a significantly higher number of these accelerations than forwards ($p < 0.05$).

Regarding the number of accelerations performed in ACC 50–75% acceleration efforts with an initial speed of 7.1–14.3 km/h, the results showed statistically significant differences between the different positions (F(4;324.494) = 8.388; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.044$). In particular, post hoc analysis showed that lateral defenders performed significantly fewer accelerations of these characteristics than players in the other positions ($p < 0.001$ for comparisons with center midfielders and lateral midfielders; $p < 0.01$ for comparisons with central defenders and forwards).

Regarding the number of accelerations performed in ACC 50–75% acceleration efforts with an initial speed > 14.3 km/h, the results showed statistically significant differences between the different positions (F(4;303.608) = 5.869; $p < 0.001$) with a small effect size ($\eta_p^2 = 0.028$). In particular, post hoc analysis showed that midfielders performed significantly fewer accelerations of these characteristics than central defenders and lateral midfielders ($p < 0.001$ for both comparisons).

Regarding the number of accelerations performed in ACC acceleration efforts > 75% with an initial speed of 0–7 km/h, the results showed no statistically significant differences between the different positions (F(4;376) = 1.023; $p > 0.05$; $\eta_p^2 = 0.011$).

Regarding the number of accelerations performed in ACC acceleration efforts > 75% with an initial speed of 7.1–14.3 km/h, the results showed statistically significant differences between the different positions (F(4;147.681) = 6.515; $p < 0.001$) with a mean effect size of $\eta_p^2 = 0.075$. In particular, post hoc analysis showed that lateral midfielders performed significantly more accelerations than lateral defenders and midfielders ($p < 0.001$ and $p < 0.01$, respectively).

Regarding the number of accelerations performed in ACC acceleration efforts > 75% with an initial speed >14.3 km/h, the results showed statistically significant differences between the different positions (F(4;126.035) = 4.386; $p < 0.01$) with a mean effect size of $\eta_p^2 = 0.075$. Specifically, post hoc analysis showed that forwards performed significantly more accelerations than lateral backs and midfielders (>0.05 for both comparisons) (Table 4).

Table 4. Number of accelerations according to playing position.

Initial Velocity	**Central Defender (CD)**	**Fullback (FB)**	**Midfielder (MF)**	**Wide Midfielder (WMF)**	**Forward (FW)**	**One-Way ANOVA (F/Df; *p*-Value) (η_p^2)**
0–7 km/h						
Number of accelerations (50–75% ACCmax)	27.61 ^{bcde} (25. 41; 19. 82)	16.57 ^{ac} (15.33; 17.80)	20.14 ^{abe} (18.78; 21.50)	20.22 ^{a} (18.02; 22.43)	17.00 ^{ac} (15.47; 18.52)	(F(4;318.822) = 21.267; $p < 0.001$) ($\eta_p^2 = 0.107$)
Number of accelerations (>75% ACCmax)	1.70 (1.39; 2.02)	1.60 (1.40; 1.79)	1.77 (1.57; 1.97)	1.56 (1.35; 1.78)	1.48 (1.23; 1.73)	NS
7.1–14.3 km/h						
Number of accelerations (50–75% ACCmax)	17.50 ^{b} (16.16; 18.85)	14.55 ^{abde} (13.37; 15.73)	19.16 ^{b} (17.84; 20.48)	20.57 ^{b} (17.90; 23.23)	17.97 ^{b} (16.36; 19.58)	(F(4;324.494) = 8.388; $p < 0.001$) ($\eta_p^2 = 0.044$)

Table 4. *Cont.*

Initial Velocity	Central Defender (CD)	Fullback (FB)	Midfielder (MF)	Wide Midfielder (WMF)	Forward (FW)	One-Way ANOVA (F/Df; p-Value) (η_p^2)
Number of accelerations (>75% ACCmax)	2.15 (1.73; 2.57)	1.52 ^{d} (1.37; 1.67)	1.76 ^{d} (1.53; 1.99)	2.56 ^{bc} (2.11; 3.00)	1.85 (1.55; 2.15)	(F(4;147.681) = 6.515; p < 0.001) (η_p^2 = 0.075)
>14.3 km/h						
Number of accelerations (50–75% ACCmax)	8.39 ^{c} (7.36; 9.42)	6.98 (6.21; 7.76)	6.15 ^{ad} (5.61; 6.68)	8.17 ^{c} (7.23; 9.12)	7.33 (6.49; 8.17)	(F(4;303.608) = 5.869; p < 0.001) (η_p^2 = 0.028)
Number of accelerations (>75% ACCmax)	1.75 (1.48; 2.02)	1.32 ^{e} (1.17; 1.97)	1.31 ^{e} (1.18; 1.44)	1.60 (1.36; 1.85)	1.90 ^{bc} (1.46; 2.35)	(F(4;126.035) = 4.386; p < 0.01) (η_p^2 = 0.075)

Abbreviations: ACCmax, maximum acceleration; m/s^{-2}, meters per second squared; km/h, kilometers per hour; NS, not significant. [a] Significant difference with CD; [b] significant difference with FB; [c] significant difference with MF; [d] significant difference with WMF; [e] significant difference with FW.

4. Discussion

The purpose of this study was to quantify the specific demands of external load in semi-professional soccer players by examining relative thresholds based on individual capacities and observing significant differences in speed and acceleration profiles according to playing position.

The high variability in activity patterns within the team and between positions underscores the need for an individualized approach to monitor external loading and the need for specific physical training to prepare players for the specific demands of each playing position [14,32,35,60].

Fullbacks

Despite being the position with the highest maximum speed, at 33.3 km/h, fullbacks were the players with the least total distance, distance at moderate intensity, and distance at high intensity. For very-high-intensity distance (or sprinting), they were second only to the CDs, but they did not outperform any other playing position significantly. Interestingly, their sprint number in zone 5 was among the lowest, which does not match the distance covered in this zone. This could be explained by the fact that FBs start very-high-speed actions from behind and accumulate large sprint distances but perform few such actions. In both distance and number of accelerations of both intensities and from any starting speed, they were the players who accumulated the least acceleration activity throughout the week.

These findings disagree with the current literature that describes FBs with high-intensity activity and a large number of sprints and accelerations [61–63]. One possible explanation is the inclusion in our study of training sessions when most studies focus only on matches. Therefore, the demands of training sessions for FBs might not reflect the demands of matches. In addition, FBs are usually players with high physical capacities, and the absolute thresholds used in the current evidence overestimate their abilities [45,64].

Central Defenders

Being the second-slowest position with a Vmax of 31.5 km/h and with the lowest maximum acceleration capability from running with 3.48 m/s^{-2} and from standing next to MF (6.21 m/s^{-2}) with 6.23 m/s^{-2}, CDs were one of the positions with the highest very-high-speed distance and acceleration activity, with the highest total distance accelerating at high intensity and the greatest distance and number of accelerations with moderate intensity from standing and running. There is a trend in the scientific evidence which describes CDs as the position with the lowest intensity in both speed and acceleration profiles [38,44,63]. In a recent study, CDs turned out to be the position with the highest values in acceleration variables [45]. Today, the physical characteristics of CDs are not clear. A possible explanation without entering the assessment of contextual variables is the fact of underestimating the physical capacity of CDs using absolute thresholds. Our results showed a low physical capacity of Vmax and maximal acceleration from 0–7 km/h or 7.1–14.3 km/h, and this was where they performed better than the other demarcations.

Central midfielders

This was the position with the lowest maximum speed at 30.7 km/h and with the lowest maximum acceleration capability regardless of initial speed. Significantly, it was the position with the largest total distance, with more distance at moderate and high intensities, more sprinting, but with less very-high-intensity distance. For the acceleration profile, central midfielders had little capacity for high-intensity acceleration except from standing, and for moderate-intensity accelerations, their capacity was greatest from standing and jogging. From running was the position with the least acceleration capacity at both intensities.

These results are generally in agreement with the literature with the exception of distance run and number of high-intensity actions. It is often described as a position with high activity, but mainly low to moderate intensity, probably being a more positional role [43,44,63].

Wide midfielders

Wide midfielders are characterized as one of the positions with the highest speed and acceleration capacity, with a maximum speed of 32.7 km/h and a maximum acceleration higher than the other positions due to jogging and running. In the speed profile, their activity was very similar to that of the MFs, with the second-highest total distance and distance at moderate–high intensity and the lowest distance at very high intensity. Conversely, their acceleration profile was one of the most complete, as was that of the CDs, with greater demands from jogging. Many authors describe WMFs as the post with the highest maximum speed and best acceleration capacity, with high-intensity physical activities and a large number of accelerations and sprints. Therefore, our findings are in line with the current literature for WMFs, being a highly demanding position in both profiles [38,44,64–66].

Forwards

With above-average data in their maximum speed and acceleration capacity, this was the post with the highest maximum acceleration capacity from standing with 6.52 m/s^{-2}. Forwards accumulated little distance regardless of the intensity of the speed profile, and this was the post with the greatest distance and number of high-intensity accelerations from running. Oliva-Lozano et al. identified the maximum velocity of FWs as the main factor that allows them to maximize their acceleration capacity, as well as WMFs [38]. That interpretation would be valid for our study with an initial velocity in acceleration efforts > 14.3 km/h. In general, players with more offensive tasks perform more explosive actions at very high intensity, shorter total distances, and more limited moderate-intensity activity [61].

Due to methodological differences, the interpretation and direct comparison of the data with previous research were complex, and further studies are recommended considering the influence of contextual, environmental, or situational factors, such as match location, quality of the opponent, match outcome, etc. [63,67–69].

5. Limitations

It is important to note that the data do not differentiate between the various days of the microcycle due to the categorization of the sample by player position. Introducing an additional specific approach to the analysis would have resulted in negligible statistical power [70]. In addition, as this study was descriptive, it was not possible to determine the causes of positional changes in the relative profiles of speed and acceleration. However, we acknowledge the potential influence of contextual variables such as the tactical system, location, match outcome, competitive level, day of the training session or match, and training methodology [44,70].

6. Conclusions

This study supports the claim that individualized acceleration and velocity profiles depend on playing position and that different training strategies can be adopted to improve match performance or to try to decrease the risk of injury [38]. The physical demands of central defenders and central midfielders tend to be underestimated when compared to a quantification of the load with absolute thresholds, which is not negligible given that these are the positions that suffer the most from injuries.

7. Practical Applications

These results can assist sports scientists, medical staff, and coaches in understanding the variability in relative speed and acceleration profiles to design individualized training programs tailored to the specific positional demands of each soccer player. For example, the load for central defenders and midfielders is often underestimated due to their relatively lower maximum physical capacities. For instance, the use of percentages in relative individualization could facilitate the direct comparison of external load variables with different devices. This is particularly relevant for accelerometer variables, considering the variability among devices or different brands.

Regarding the rehabilitation process, during the gradual return of the player to the field, both physiotherapists and fitness trainers have questioned whether the player is ready for group training sessions and subsequently returning to competition. Measuring external load in an individualized manner, based on the player's current maximum physical capabilities, could optimize quantification in each phase of rehabilitation to ensure performance and minimize the risk of relapse or recurrence. Additionally, our results could provide semi-professional Spanish soccer players with reference information about the maximum physical capabilities they need to achieve to reintegrate into training or competition.

Utilizing individualized speed and acceleration profiles based on the maximum capacities of semi-professional soccer players can significantly alter positional characteristics by considering both the initial speed and action intensity. This approach facilitates the design of new strategies for monitoring external load and enhances the functional specificity of training by quantifying variables with relative thresholds. Additionally, relative individualization through the use of percentages allows for direct comparison of external load variables across different devices.

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