

Article

The effect of substitutions on match running performance and tactical-technical variables in the Qatar 2022 World Cup

Borja Sanabria-Pino¹, David Lobo-Triviño^{1,2}, Jorge Polo-Tejada¹, Tomás García-Calvo^{1,2}, Jose Miguel Encinas-Borrego¹, José Carlos Ponce-Bordón^{1,2*}

¹ Faculty of Sport Sciences, University of Extremadura, Cáceres, Spain

² University Institute for Research and Innovation in Sport, University of Extremadura, Cáceres, Spain

* Correspondence: (JCPB) joponceb@unex.es  ORCID ID nº 0000-0002-5641-6748

Received: 19/11/2025; Accepted: 12/12/2025; Published: 30/06/2026

Abstract: This study aimed to analyze the impact of substitutions on players' match running and tactical-technical performance during the FIFA World Cup Qatar 2022, considering the type of substitutions. Sixty-four games were analyzed during the competition using a multi-camera computerized tracking system. A total of 1,994 individual observations from 727 international players were examined. Players were categorized according to their match participation as Starters ($n = 826$), Non-Starters ($n = 686$), and Replaced players ($n = 581$), while substitutions were also classified according to their playing line and, subsequently, as Offensive, Neutral, or Defensive. Match running performance variables analyzed included total distance (TD), very high-speed running (VHSR), sprint distance (Sprint), high-intensity efforts, and sprint efforts. Tactical variables encompassed goals, line-breaking passes, crosses, defensive actions, possessions regained, tackles won and completed passes. Linear Mixed Models showed that Non-Starters players reached significantly higher match running performance compared to both, Starters and Replaced players, with greater TD ($p < .001$), VHSR ($p < .001$), and Sprint efforts ($p < .001$). Regarding substitution types, Offensive substitutions demonstrated significantly more completed crosses than Neutral ($p < .05$), while Defensive substitutions performed significantly lower interceptions than Neutral ($p < .01$) and Offensive ($p < .001$) substitutions. Also, Same-line substitutions exhibited significantly higher line-breaking pass performance than Different-line substitutions ($p < .05$). Consequently, Non-Starter players maintain match intensity and contribute to the team's tactical performance based on their specific roles. This study provides relevant information for coaches to enhance their tactical decisions, maximizing player effectiveness, and sustaining performance levels throughout a match.

Keywords: football; external load; international; monitoring; match analysis; tournament.



1. Introduction

Match analysis in sport performance has become a fundamental tool in the training process of modern soccer (Hughes & Franks, 2004). Consequently, professional clubs and national teams have increasingly integrated data and performance analysts to better understand their own gameplay and opponent strategies (Santos et al., 2018). In addition, tactical behavior analysis now uses match positional data (Claudino et al., 2021; Sampaio & Leite, 2013). For this reason, physical and tactical-technical behavior represents one of the most extensively studied aspects of soccer performance. Particularly relevant in international tournaments like the FIFA World Cup, which presents unique tactical and physical challenges due to its competitive level and tournament format (Kvas-Cabral et al., 2022; Modrić et al., 2023; Vergonis et al., 2019).

National teams operate under limited preparation time and compete under high-pressure conditions, hindering the implementation of complex tactical systems and leading coaches to prioritize simplified strategies, tactical flexibility, and individual player quality (Kołodziejczyk et al., 2021). Within this context, substitutions represent an interesting intervention enabling coaches to execute dynamic and different tactical match conditions (Varley et al., 2018). In addition, the FIFA World Cup Qatar 2022 was the first World Cup conducted under the five-substitution rule, initially introduced by IFAB in 2020 to mitigate player fatigue during the congested post-COVID-19 calendar and made permanent by FIFA in 2022 (International Football Association Board-IFAB, 2022; López-Valenciano et al.,

2023). This regulation allows up to five substitutions across three windows during regulation time (excluding half-time), fundamentally increasing tactical flexibility compared to the previous three-substitution limit (FIFA, 2022).

However, research on substitutions presents limitations. Most studies have focused on domestic leagues, which differ substantially from short-duration competitions such as the FIFA World Cup (Cao et al., 2025). Concretely, international tournaments present different physiological demands than domestic leagues due to their compressed fixture schedules. While domestic leagues typically allow 7 days between matches, international tournaments provide only 3-4 days for recovery. Under these conditions, substitutions become a key strategy for managing player workload and reducing injury risk, since allow for more flexible squad rotation strategies (García-Aliaga et al., 2023).

The impact of substitutions on match performance has been extensively studied (Pan et al., 2023). Concerning the effect of substitutions on match running performance (MRP), extensive research has established that substitute players demonstrate higher MRP compared to starters, particularly in total distance (TD) per minute and number of sprints performed per minute (Castillo-Rodríguez et al., 2023; Wang & Zhai, 2025). This higher MRP has been attributed to less match playing time, which allows substitutes to maintain higher energy expenditure without employing pacing strategies. Furthermore, strategic use of substitutions can reduce overall physical demands on players, potentially lowering injury risk

(García-Aliaga et al., 2023; Meyers, 2013; Padrón-Cabo et al., 2018).

Substitutions also significantly influence tactical-technical performance, particularly enhancing teams' ability to generate scoring opportunities (Gómez et al., 2016). Key performance indicators in soccer include ball possession, successful passing, shots on target, crosses, and completed dribbles with passing accuracy and shot frequency being particularly linked to higher team performance levels (Oliveira et al., 2019). Evidence indicates that substitutes outperform replaced and full-match players in technical variables such as possession, touches, and shots (Lorenzo-Martínez et al., 2021).

Nevertheless, there is a notable lack of studies simultaneously examining the tactical-technical effects of substitutions, the substitution type (offensive, defensive, or neutral), and the positional role of players (same or different position). Understanding substitutions from a tactical perspective is crucial for optimizing tactical decisions in elite international soccer. For instance, it has been reported that offensive substitutions enhance space control in the attacking third and increase goal-scoring opportunities, while defensive substitutions improve team compactness and defensive effectiveness (Lorenzo-Martínez, et al., 2022).

Therefore, this study aimed to analyze the impact of substitutions on players' match running and tactical-technical performance during the FIFA World Cup Qatar 2022, considering both substitution type (i.e., offensive, defensive, or neutral) and whether Non-Starters played in the same or different playing line. We hypothesized that: (1) Non-Starters players would exhibit higher MRP to

Starters and Replaced players; (2) Non-Starters players would complete a higher number of tactical-technical actions than Starters and Replaced players; and (3) match running and tactical-technical performance would differ between substitution types (i.e., offensive, defensive, neutral) and between playing line substitutions (Same-line vs Different-line substitutions).

2. Materials and Methods

Study Design – The design of this study was retrospective, observational, and analytical based on a single competition. To examine the differences in MRP and tactical-technical variables based on player participation in the 2022 FIFA World Cup in Qatar, a total of 64 games during the FIFA World Cup Qatar 2022 were analyzed. Analyses involved the examination of the MRP and tactical-technical variables of individual players in various positional roles in the team. Players and substitutions were categorized according to three criteria: i) to their match participation: Starters (i.e., players who began the match in the starting eleven and completed the full match; $n = 826$ observations), Non-Starters (i.e., players who entered as substitutes, $n = 686$ observations), and Replaced (i.e., players who started but were subsequently substituted and did not complete the match, $n = 581$ observations); ii) by playing line: Same-line substitutions (i.e., both players competed in the same line and maintained the tactical system; for instance, a full back replaced to another full back or central back), and Different-line substitutions (i.e., players replaced competed in different line and did not maintain the tactical system; for instance, a wide midfielder replaced to a full back); and iii) by tactical aim (Del Corral

et al., 2008; Rey et al., 2015): Defensive substitutions (i.e., a player replaced to another from a more backward line; for instance, a midfielder replaced to a central back or a forward replaced to a midfielder), Offensive substitution (i.e., a player replaced

to another from a more forward line; for instance, a wide midfielder replaced to a winger or a full back replaced to a wide midfielder); and Neutral (i.e., incoming and outgoing players competed in the same line)

Table 1. Tactical-technical variables definitions.

Item	Definition
Goal	The primary objective of the game is to score a goal or point. A goal is considered valid when the entire ball crosses the goal line.
Line Break	A player progresses the ball and breaks one or more-unit lines of the opposition team shape.
LB Through	A player breaks one or more opposition units by distributing the ball through them. The ball must travel between the two widest players of a unit, below head height.
LB Around	A player breaks an opposition unit by distributing the ball around the unit(s) in the opposition team shape. The ball must travel around the two widest players of a unit.
LB Over	A player breaks an opposition unit by distributing the ball over the unit(s) in the opposition team shape. The ball must travel above head height.
Crosses	A distribution action performed by a player with the intention of creating a goalscoring opportunity. The player can play the ball on the ground or aerially from any crossing zone with the intention of finding a team-mate inside the recognized target area.
Ball progressions	A distribution action performed by a player with the intention of breaching the opposition team shape by intentionally passing one or more opposition players whilst carrying the ball into space or directly beyond an opponent.
Total Offers Made	When a player has actively changed body shape or made a clear movement to receive the ball. Involves moving to a different area from which it started.
Possessions regained	Involves winning the ball back, this can be done by applying pressure on the opposite team, winning duels, interceptions or loose-ball. Includes any defensive actions which allow to win the ball back.
Tackles	A player attempts to tackle an opposition player using their body whilst staying on their feet.
Interceptions	An interception in football is when a defensive player disrupts an offensive pass.
Total passes completed	Measures how many successfully pass completed the player.
Total crosses completed	Measures how many successfully crosses the player completed.

Note. LB = Line Break.

Subjects — The sample for this study consisted of a total of 1,994 individual match

observations from 727 international soccer players. It should be highlighted that each

individual match observation corresponds to a player-match observation, and the same player can appear in multiple matches. All players who participated in the matches were included in the study, including goalkeepers. No ethical approval was required, as the data were publicly available without restrictions on the official FIFA website (<https://www.fifatrainingcentre.com/en/>) and are freely accessible (FIFA, 2022).

Variables — The following tactical-technical variables were considered (see Table 1). The definitions of the variables used in this study were obtained from the official FIFA website: <https://www.fifatrainingcentre.com/en/resources-tools/football-language/index.php>. Absolute values of tactical-technical variables were normalized to relative values per unit of time to consider the possible differences in the total playing time of soccer matches.

Match Analysis System — All FIFA World Cup Qatar 2022 games were analyzed using a multicamera computerized tracking system TRACAB (ChyronHego®, United States). All player movements were captured by high-definition cameras operating at 25 Hz. This system's validity has been quantified to verify the capture process and subsequent accuracy of the data (Pons et al., 2019). MRP data were divided into the following categories: total distance covered by soccer players in meters (TD); very high-speed running (VHSR, distance covered between 20 – 24.9 km·h⁻¹); sprinting speed running distance (Sprint, > 25 km·h⁻¹). Likewise, the number of very high-intensity efforts performed per minute was also divided into two speed ranges: the number of very high intensity running efforts between 20 and 24.9

km·h⁻¹ (i.e., VHSR efforts) and the number of sprints at speeds above 25 km·h⁻¹ (i.e., HSR efforts). Similarly to tactical-technical variables, absolute values of MRP variables were normalized to relative values per unit of time to consider the possible differences in the total playing time of soccer matches.

Statistical Analysis — All statistical analyses were performed using the software RStudio (version 2024.12.0+467) and the *dplyr*, and *tidyr* packages for data manipulation and statistical calculations. Considering the characteristics of the sample, which is hierarchically organized, nested in groups, and with a longitudinal structure, the most appropriate procedure for analyzing the data was Linear Mixed Models (LMM). LMM has been demonstrated to cope with unbalanced and repeated measures of data (Heck & Thomas, 2020). For instance, MRP variables in the matches are nested within players (i.e., each player has a record for every match they participated in, and each match contains observations from several players). Thus, cross-classified multilevel models are suitable for data structures that are not purely hierarchical. Therefore, a general multilevel modelling strategy was applied, including both fixed and random effects in different steps (Heck & Thomas, 2020). Also, given the ability of LMMs to explicitly model random effects and account for data dependencies, additional tests for these assumptions were not deemed necessary.

To examine differences in tactical-technical variables and MRP between different player participation, LMM was conducted. First, the tactical-technical and MRP variables were included as dependent variables in the models, and the type of

player participation (i.e., Starter, Replaced or Non-Starters), the difference in the new player (i.e., Same-line or Different-line), and the type of substitution (i.e., Offensive, Defensive, or Neutral) were the independent variables included as fixed effects in the analysis. Additionally, post-hoc comparisons were performed using the *emmeans* package to obtain marginal means of the dependent variables for each substitutions type and to compare differences between substitutions. The variable player was considered a random effect in the analysis. Values were presented as coefficients and standard error (Coef $\pm$ SE). Statistical significance was set at $p < .05$. Finally, to assess statistical significance, Cohen's effect sizes (ES; Cohen, 2013) were also calculated to quantify the magnitude of differences observed in between-substitutions type comparisons on match running and tactical-technical performance. The thresholds for effect size interpretation were set as follows: trivial (<0.20), small (0.20 – 0.59), moderate (0.60 – 1.19), large (1.20 – 1.99), very large (2.00 – 3.99), and extremely large (>4.00).

3. Results

All the reported values throughout this section are the model-estimated (adjusted) coefficients. Table 2 showed the differences between player participation on MRP. Non-Starters players covered significantly higher TD compared to Starter players ($p < .001$; ES = .93) and Replaced players ($p < .001$; ES = 1.05); higher VHRS than Starter players ($p < .001$; ES = .86) and Replaced players ($p < .001$; ES = .66); and higher Sprint than Starter players ($p < .001$; ES = .74) and Replaced

players ($p < .001$; ES = .70). In addition, Non-Starter players performed significantly higher number of VHRS efforts compared to Starter players ($p < .001$; ES = 1.04) and Replaced players ($p < .001$; ES = .84); and higher number of Sprints efforts than Starter players ($p < .001$; ES = 1.01) and Replaced players ($p < .001$; ES = .84). Table 3 showed the differences between player participation on tactical-technical variables. Non-Starter players scored significantly higher number of Goals compared to Starter players ($p < .001$; ES = .20) and Replaced players ($p < .05$; ES = .13); performed higher number of Crosses than Starter ($p < .001$; ES = .32) and Replaced players ($p < .001$; ES = .37); and higher number of Ball progressions than Starter players ($p < .001$; ES = .31) and Replaced players ($p < .001$; ES = .30). Moreover, Non-Starter players completed a significantly higher number of Total Offers Made compared to Starter players ($p < .001$; ES = .88) and Replaced players ($p < .001$; ES = .68); a significantly higher number of Possessions regained than Starter players ($p < .01$; ES = .21) and Replaced players ($p < .001$; ES = .38); a significantly higher number of Tackles than Starter players ($p < .01$; ES = .21) and Replaced players ($p < .01$; ES = .20); a significantly higher number of Total passes completed than Starter players ($p < .001$; ES = .33) and Replaced players ($p < .001$; ES = .57); and a significantly higher number of Completed crosses than Starter players ($p < .001$; ES = .38) and Replaced players ($p < .001$; ES = .46).

Table 2. Match running performance differences according to player match participation.

Variables	Starter	Replaced	Non-Starter	<i>p</i>	<i>d</i> (CI _{95%})		
	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)		Starter vs Replaced	Starter vs Non-Starter	Replaced vs Non-Starter
TD (m·min ⁻¹)	111 (1.05)	110 (1.06)	122 (1.32)	b ^{***} , c ^{***}	.12 (-.04, .29)	-.93 (-1.16, -.70)	-1.05 (-1.27, -.83)
VHSR (m·min ⁻¹)	6.47 (.13)	6.81 (.14)	7.95 (.18)	a ^{***} , b ^{***} , c ^{***}	-.20 (-.36, -.04)	-.86 (-1.07, -.64)	-.66 (-.86, -.45)
Sprint (m·min ⁻¹)	2.29 (.08)	2.34 (.08)	3.15 (.11)	b ^{***} , c ^{***}	-.04 (-.20, .11)	-.74 (-.95, -.53)	-.70 (-.90, -.50)
VHSR efforts (no.)	1.27 (.02)	1.35 (.02)	1.53 (.03)	a ^{***} , b ^{***} , c ^{***}	-.30 (-.46, -.13)	-1.04 (-1.27, -.81)	-.75 (-.96, -.53)
Sprints efforts (no.)	.51 (.01)	.53 (.01)	.64 (.01)	a ^{***} , b ^{***} , c ^{***}	-.18 (-.34, -.02)	-1.01 (-1.23, -.79)	-.84 (-1.04, -.63)

Note. Coeff = Coefficient; SE = Standard Error; CI = Confident Intervals; m·min⁻¹ = meters per minute; TD = Total Distance; VHSR = Very High-Speed Running; Sprint = Sprinting speed running; VHSR efforts = Number of efforts between 20 and 24.9 km·h⁻¹; Sprint efforts = Number of efforts >25 km·h⁻¹; a = significant differences between Starter and Replaced; b = significant differences between Starter and Non-Starter; c = significant differences between Replaced and Non-Starter; ****p* < .001.

Regarding line-breaking actions, Starter players showed a significantly higher number of Line Breaks compared to Replaced (*p* < .001; ES = .36) players. However, Non-

Starter players performed a significantly higher number of LB Through than Starter (*p* < .01; ES = .21) and Replaced (*p* < .001; ES = .33) players

Table 3. Differences on tactical-technical variables according to player match participation.

Variables	Starter	Replaced	Non-Starter	<i>p</i>	<i>d</i> (CI _{95%})		
	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)		Starter vs Replaced	Starter vs Non-Starter	Replaced vs Non-Starter
Goal	.001 (.00)	.002 (.00)	.003 (.00)	b ^{***} , c [*]	-.07 (-.18, .04)	-.20 (-.31, -.09)	-.13 (-.25, -.01)
Line Break	.139 (.00)	.103 (.00)	.160 (.00)	a ^{***} , b ^{**} , c ^{***}	.36 (.23, .49)	-.21 (-.35, -.07)	-.57 (-.71, -.43)
LB Through	.037 (.00)	.030 (.00)	.049 (.00)	a [*] , b ^{**} , c ^{***}	.12 (-.00, .24)	-.21 (-.34, -.08)	-.33 (-.46, -.20)
LB Around	.047 (.00)	.039 (.00)	.059 (.00)	a [*] , b ^{**} , c ^{**}	.16 (.02, .29)	-.21 (-.35, -.07)	-.36 (-.50, -.22)
LB Over	.055 (.00)	.037 (.00)	.053 (.00)	a ^{***} , b ^{***}	.38 (.24, .51)	.04 (-.11, .19)	-.33 (-.48, -.19)
Crosses	.004 (.00)	.004 (.00)	.008 (.00)	b ^{***} , c ^{***}	.05 (-.10, .20)	-.32 (-.50, -.14)	-.37 (-.53, -.20)
Ball progressions	.005 (.00)	.005 (.00)	.010 (.00)	b ^{***} , c ^{***}	-.01 (-.12, .11)	-.31 (-.43, -.19)	-.30 (-.43, -.18)
Total Offers Made	.492 (.01)	.617 (.02)	1.045 (.02)	a ^{**} , b ^{***} , c ^{***}	-.20 (-.32, -.08)	-.88 (-1.10, -.74)	-.68 (-.81, -.54)
Possessions regained	.050 (.00)	.037 (.00)	.066 (.00)	a ^{**} , b ^{**} , c ^{***}	.17 (.04, .30)	-.21 (-.35, -.07)	-.38 (-.52, -.24)
Tackles	.007 (.00)	.008 (.00)	.017 (.00)	b ^{**} , c ^{**}	-.02 (-.13, .10)	-.21 (-.33, -.09)	-.20 (-.32, -.07)

Interceptions	.008 (.00)	.006 (.00)	.008 (.00)		.11 (-.00, .22)	.01 (-.10, .12)	-.10 (-.22, .02)
Total passes completed	.433 (.02)	.348 (.02)	.552 (.02)	a ^{***} , b ^{***} , c ^{***}	.24 (.10, .37)	-.33 (-.47, -.19)	-.57 (-.71, -.42)
Completed crosses	.006 (.00)	.005 (.00)	.011 (.00)	b ^{***} , c ^{***}	.08 (-.08, .24)	-.38 (-.58, -.18)	-.46 (-.64, -.29)

Note. Coeff = Coefficient; SE = Standard Error; CI = Confident Intervals; LB = Line Break; a = significant differences between Starter and Replaced; b = significant differences between Starter and Non-Starter; c = significant differences between Replaced and Non-Starter; * $p < .05$; ** $p < .01$; *** $p < .001$.

Differences between substitution types based on playing line (i.e., Same Line vs. Different Line) were shown in Table 4. Same Line substitutions performed a significantly higher number of LB and LB Through compared to Different Line

substitutions ($p < .05$; ES = .15; $p < .05$; ES = .12, respectively). No other significant differences were observed between substitution types by playing line for any other tactical-technical variable.

Table 4. Differences on tactical-technical variables according to playing line of substitutions.

Variables	Different Line	Same Line	p	d (CI _{95%})
	Coeff (SE)	Coeff (SE)		
Goal	.002 (.00)	.003 (.00)	.800	-.02 (-.14, .11)
Line Break	.117 (.01)	.136 (.01)	*	-.15 (-.29, -.01)
LB Through	.033 (.00)	.043 (.00)	*	-.12 (-.25, .00)
LB Around	.044 (.00)	.050 (.00)	.166	-.09 (-.22, .04)
LB Over	.040 (.00)	.044 (.00)	.244	-.09 (-.24, .06)
Crosses	.006 (.00)	.006 (.00)	.662	-.03 (-.19, .12)
Ball progressions	.009 (.00)	.008 (.00)	.491	.04 (-.08, .16)
Total Offers Made	.825 (.04)	.851 (.03)	.621	-.03 (-.15, .09)
Possessions regained	.053 (.01)	.048 (.00)	.533	.04 (-.09, .17)
Tackles	.013 (.00)	.012 (.00)	.773	.02 (-.11, .14)
Interceptions	.007 (.00)	.007 (.00)	.489	-.04 (-.16, .08)
Total passes completed	.419 (.03)	.452 (.02)	.317	-.07 (-.20, .07)
Completed crosses	.009 (.00)	.009 (.00)	.772	-.03 (-.20, .15)

Note. Coeff = Coefficient; SE = Standard Error; CI = Confident Intervals; LB= Line Break; * $p < .05$.

Differences between tactical aim substitutions (i.e., Defensive, Neutral, and Offensive substitutions) are summarized in Table 5. Defensive substitutions performed a significantly lower number of Interceptions compared to Neutral ($p < .01$; ES = -.22) and Offensive ($p < .001$; ES = -.09) substitutions;

and a significantly lower number of Completed crosses than Offensive substitutions ($p < .05$; ES = -.26). No other significant differences were observed between tactical aim substitution for the remaining tactical-technical variables.

Table 5. Differences on tactical-technical variables according to the tactical aim of substitutions.

Variables	Defensive	Neutral	Offensive	<i>p</i>	<i>d</i> (CI _{95%})		
	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)	<i>Coeff</i> (SE)		Defensive vs Neutral	Defensive vs Offensive	Neutral vs Offensive
Goal	.001 (.00)	.003 (.00)	.003 (.00)		-.09 (-.24, .06)	-.15 (-.33, .04)	-.06 (-.21, .10)
Line Break	.116 (.01)	.136 (.01)	.117 (.01)		-.15 (-.33, -.02)	-.01 (-.22, .20)	.14 (-.02, .31)
LB Through	.033 (.00)	.043 (.00)	.035 (.00)		-.14 (-.30, .02)	-.04 (-.23, .15)	.10 (-.05, .26)
LB Around	.043 (.01)	.050 (.00)	.045 (.01)		-.10 (-.27, -.06)	-.02 (-.22, .18)	.08 (-.08, .24)
LB Over	.041 (.00)	.044 (.00)	.038 (.00)		-.06 (-.25, .13)	.06 (-.17, .28)	.12 (-.07, .30)
Crosses	.004 (.00)	.006 (.00)	.007 (.00)		-.12 (-.32, .08)	-.16 (-.39, .08)	-.04 (-.24, .15)
Ball progressions	.008 (.00)	.008 (.00)	.010 (.00)		.00 (-.15, .15)	-.08 (-.26, .11)	-.08 (-.23, .07)
Total Offers Made	.788 (.06)	.852 (.04)	.860 (.06)		-.07 (-.23, .08)	-.08 (-.27, .11)	-.01 (-.16, .14)
Possessions regained	.051 (.01)	.048 (.00)	.053 (.01)		.03 (-.13, .20)	-.01 (-.21, .18)	-.05 (-.21, .12)
Tackles	.015 (.00)	.012 (.00)	.011 (.00)		.05 (-.10, .21)	.07 (-.12, .26)	.02 (-.14, .17)
Interceptions	.003 (.00)	.007 (.00)	.010 (.00)	a**, b***	-.22 (-.37, -.07)	-.34 (-.52, -.16)	-.12 (-.27, .03)
Total passes completed	.397 (.04)	.452 (.02)	.441 (.04)		-.12 (-.29, .05)	-.09 (-.30, .11)	.02 (-.14, .20)
Completed crosses	.006 (.00)	.009 (.00)	.011 (.00)	b*	-.16 (-.38, .06)	-.26 (-.51, -.00)	-.10 (-.31, .11)

Note. Coeff = Coefficient; SE = Standard Error; CI = Confident Intervals; LB= Line Break; a = significant differences between Defensive and Neutral; b = significant differences between Defensive and Offensive; c = significant differences between Neutral and Offensive; **p* < .05; ***p* < .01; ****p* < .001.

4. Discussion

This study advances our understanding of substitution effectiveness by analyzing both match running and tactical-technical performance in elite international competition. The main findings were: (i) Non-Starters significantly outperformed Starters and Replaced players in all MRP variables; (ii) Non-Starters demonstrated significantly higher tactical-technical performance in offensive (goals, crosses, progressions, passes) and defensive actions (tackles, regains); and (iii) substitutions type

by playing line and tactical aim showed minimal influence on match performance.

Based on previous studies (Pan et al., 2023), our first hypothesis established that Non-Starter players would demonstrate higher MRP values compared to Starters and Replaced players. Our results showed that Non-Starters consistently outperformed both other groups across all MRP metrics. These findings align with recent research by Wei et al. (2024), who observed similar patterns in both Men's and Women's World Cup competitions, where Non-Starter players demonstrated significantly higher MRP

across all running metrics compared to Starters. The higher MRP of Non-Starters can be attributed to several factors. Primarily, their reduced playing time allows for greater energy expenditure without the need for pacing strategies throughout the entire match duration (Pan et al., 2023). This higher performance in VHSR is specifically targeted by coaches when making substitutions to maintain or increase match pace (Hills et al., 2018). Furthermore, the distinctive characteristics of World Cup competition—including fixture congestion and elevated competitive demands—emphasize the importance of substitution strategies for fatigue management. On the other hand, the main reason by Replaced players also exhibited greater VHSR compared to Starters suggests that fatigue accumulation affects physical output even before substitution occurs, reducing the MRP in players who completed the entire match (García-Calvo et al., 2025). This pattern supports the tactical decisions for proactive substitutions in elite international competitions, where maintaining physical intensity can be decisive in determining match outcomes.

Concerning our second hypothesis, we expected that Non-Starters would demonstrate higher tactical-technical performance than Starters and Replaced players. The results of present study confirmed that Non-Starters exhibited greater performance per minute in most offensive (goals, line breaks, crosses, ball progressions, offers, completed crosses) and defensive actions (possessions regained and tackles). This offensive superiority is consistent with previously established tactical principles: Non-Starters entering with minimal fatigue can better identify and

exploit weaknesses in tired defensive units (Lorenzo-Martínez et al., 2021). The tactical-technical impact of Non-Starters differs according to the playing position. Offensive substitutes primarily improve team organizing performance through enhanced passing and progression actions, whereas defensive substitutes strengthen defensive performance via increased tackles and ball recoveries (Pan et al., 2023).

Analysis of LB actions revealed distinct tactical profiles. Non-Starters showed significantly higher performance in LB, particularly also breaking through and around defensive structures. This pattern reflects the tactical advantage of minimal fatigue accumulation: Non-Starters enter matches with preserved physical capacity, allowing them to identify and exploit defensive weaknesses in fatigued opponent structures (Clemente et al., 2013). The greater defensive performance of Non-Starters—evidenced by increased possessions regained and tackles—supports the principle that reduced fatigue enables sustained high-intensity defensive actions. This is especially relevant in elite international competition, where defensive compactness and pressing intensity often determine tactical success (Wang et al., 2025).

Regarding substitutions based on playing line (i.e., Same-line substitutions vs Different-line substitutions), although non-significant differences were observed in most variables, results revealed that Same-line substitutions demonstrated higher performance in most analyzed variables. Notably, only Same-line substitutions achieved significantly higher LB and LB Through performance, suggesting that positional familiarity facilitates immediate

tactical integration (Lorenzo-Martínez et al., 2022). Players entering their natural positions have inherent understanding of spatial responsibilities, movement patterns, and tactical demands, enabling maximum performance contribution. However, Different-line substitutions showed small differences in specific defensive variables, performing a higher number of possessions regained ($ES = .04$), and tackles won ($ES = .02$). This pattern may reflect the tactical deployment of defensively oriented players in different positional roles to strengthen defensive solidity.

Concerning the analysis by tactical aim substitutions, although non-significant differences were observed in most variables, Offensive substitutions showed higher values in specific attacking metrics including goals, crosses, ball progressions, total offers made, possessions regained, and interceptions compared to Defensive and Neutral substitutions. Only the number of interceptions and completed crosses were significantly higher in Offensive substitutions than the rest. This offensive superiority likely reflects their tactical purpose: offensive substitutions typically occur when teams trail or seek to change unfavorable match outcomes (Gomez et al., 2016), motivating attacking players to maximize offensive output immediately upon entry.

Conversely, Neutral substitutions performed higher number of LB (through, around, and over) and total completed passes compared to both Offensive and Defensive substitutions. This effectiveness might be showed from positional familiarity—players entering their natural roles require minimal tactical adaptation, enabling immediate

maximum performance (Pan et al., 2023). Neutral substitutions typically aim to maintain current results or inject physical freshness while preserving tactical structure (Gómez et al., 2016), explaining superior performance in organizational variables such as line breaks and passing accuracy.

Finally, Defensive substitutions recorded higher tackles won compared to Offensive and Neutral substitutions. This pattern reflects their tactical goal: defensive substitutes enter to protect favorable scorelines or prioritizing defensive actions such as tackling and positional discipline (Lorenzo-Martínez et al., 2022).

5. Practical Applications

These findings provide evidence-based guidance for optimizing substitution strategies in knock-out tournament contexts. Same-line substitutions showed greater line-breaking effectiveness, suggesting coaches should prioritize tactical familiarity when maintaining team structure is critical. Conversely, Different-line substitutions may influence team performance temporarily, necessitating careful planning and preparation. On the other hand, temporary decrease or increase in the physical activity of the entire team may lead to a change in the scoreline. So, coaches should react proactively, modifying match assumptions in the context of the passage of playing time and the changing score of the match, in order to maximize the match outcome. To sum up, coaches should develop pre-match substitution scenarios with designated players prepared for specific tactical situations, while simultaneously preparing the entire team to adjust roles and adapt to tactical decisions.

6. Conclusions

Understanding substitution effectiveness can help coaches make better tactical decisions during matches. This study showed that Non-Starter players exhibited higher MRP and performed a higher number of offensive (goals, crosses, passes) and defensive activities (possessions regained and tackles) per minute than Starters players. Also, Same-line substitutions were more effective for maintaining tactical structure, while Offensive substitutions performed greater number of completed crosses. These findings suggest that coaches should use substitutions strategically to maintain intensity and to improve specific tactical functions during soccer matches.

Funding: This work was supported by the European Regional Development Fund (ERDF), and the Government of Extremadura (Department of Economy and Infrastructure). David Lobo-Triviño was supported by a pre-doctoral fellowship (PD23068) awarded by the Junta de Extremadura (Spain) and co-financed by the European Social Fund Plus (FSE+).

Conflicts of Interest: The authors declare no conflict of interest.

References

- Cao, A., Xie, X., Zhang, R., Tian, Y., Fan, M., Zhang, H., & Wu, Y. (2025). Team-scouter: Simulative visual analytics of soccer player scouting. *IEEE Transactions on Visualization and Computer Graphics*, 31(1), 1–11. <https://doi.org/10.1109/TVCG.2024.3456216>
- Castillo-Rodríguez, A., González-Téllez, J. L., Figueiredo, A., Chinchilla-Minguet, J. L., & Onetti-Onetti, W. (2023). Starters and non-starters soccer players in competition: Is physical performance increased by the substitutions? *BMC Sports Science, Medicine and Rehabilitation*, 15(1), 33. <https://doi.org/10.1186/s13102-023-00641-3>
- Claudino, J. G., Cardoso Filho, C. A., Boullosa, D., Lima-Alves, A., Carrion, G. R., Gianoni, R. L. D. S., ... & Serrão, J. C. (2021). The role of veracity on the load monitoring of professional soccer players: a systematic review in the face of the big data era. *Applied Sciences*, 11(14), 6479. <https://doi.org/10.3390/app11146479>
- Clemente, F. M., Couceiro, M. S., Martins, F. M. L., Ivanova, M. O., & Mendes, R. (2013). Activity profiles of soccer players during the 2010 World Cup. *Journal of Human Kinetics*, 38, 201. <https://doi.org/10.2478/hukin-2013-0060>
- Cohen, J. *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed.; Lawrence Earlbaum Associates, Ed.; Routledge: Oxfordshire, UK, 2013; ISBN 978113474270.
- Del Corral, J., Barros, C. P., & Prieto-Rodríguez, J. (2008). The determinants of soccer player substitutions: A survival analysis of the Spanish soccer league. *Journal of Sports Economics*, 9(2), 160–172. <https://doi.org/10.1177/1527002507308309>
- FIFA. (2022). Five substitutes option to be made permanent. Fédération Internationale de Football Association. <https://www.fifa.com/legal/football-regulatory/news/five-substitutes-option-to-be-made-permanent>
- García-Aliaga, A., Martín-Castellanos, A., Marquina Nieto, M., Muriarte Solana, D., Resta, R., López del Campo, R., ... & Refoyo, I. (2023). Effect of increasing the number of substitutions on physical performance during periods of congested fixtures in football. *Sports*,

- 11(2), 25.
<https://doi.org/10.3390/sports11020025>
- García-Calvo, T., Lobo-Triviño, D., Ponce-Bordón, J., Sanabria-Pino, B., Del Campo, R. L., Resta, R., & Chmura, P. (2025). Do players in Spanish professional soccer leagues maintain match running performance until the end of the match? A 5-minute interval analysis by match participation. *Biology of Sport*, 42(4), 345-352. <https://doi.org/10.5114/biolSport.2025.151645>
- Gomez, M. A., Lago-Peñas, C., & Owen, A. L. (2016). The influence of substitutions on elite soccer teams' performance. *International Journal of Performance Analysis in Sport*, 16(2), 553-568. <https://doi.org/10.1080/24748668.2016.11868908>
- Heck, R. H., & Thomas, S. L. (2020). *An introduction to multilevel modeling techniques: MLM and SEM approaches using Mplus*. London, UK: Routledge.
- Hills, S. P., Barwood, M. J., Radcliffe, J. N., Cooke, C. B., Kilduff, L. P., Cook, C. J., & Russell, M. (2018). Profiling the responses of soccer substitutes: A review of current literature. *Sports Medicine*, 48(10), 2255-2269. <https://doi.org/10.1007/S40279-018-0962-9>
- Hughes, M., & Franks, I. M. (2004). Notational analysis—a review of the literature. *Notational Analysis of Sport*, 71-116.
- International Football Association Board. (2022). IFAB confirms decision on Law 3 change regarding number of substitutions. <https://www.theifab.com/news/annual-general-meeting-2022/>
- Kołodziejczyk, M., Chmura, P., Konefał, M., Chmura, J., Rokita, A., & Andrzejewski, M. (2021). The effect of squad rotation on physical activity at the 2018 World Cup in Russia. Analysis the most exploited players of the 4 best teams. *Frontiers in Psychology*, 12, 726207. <https://doi.org/10.3389/fpsyg.2021.726207>
- Kvas-Cabral, V. C., Martins, H., Oneda, G., Enes, A., Moraes, I. F., & Leonel, D. F. (2022). Physical, technical, and tactical differences between continental soccer teams participating in the 2018 FIFA World Cup. *Journal of Physical Education and Sport*, 22(6), 1507-1515. <https://doi.org/10.7752/jpes.2022.06190>
- López-Valenciano, A., Moreno-Perez, V., López-Del Campo, R., Resta, R., & Del Coso, J. (2023). The five-substitution option enhances Teams' running performance at high speed in football. *International Journal of Sports Medicine*, 44(05), 344-351. <https://doi.org/10.1055/a-1982-9808>
- Lorenzo-Martínez, M., Padrón-Cabo, A., Rey, E., & Memmert, D. (2021). Analysis of physical and technical performance of substitute players in professional soccer. *Research Quarterly for Exercise and Sport*, 92(4), 599-606. <https://doi.org/10.1080/02701367.2020.1755414>
- Lorenzo-Martínez, M., Rein, R., Garnica-Caparrós, M., Memmert, D., & Rey, E. (2022). The effect of substitutions on team tactical behavior in professional soccer. *Research Quarterly for Exercise and Sport*, 93(2), 301-309. <https://doi.org/10.1080/02701367.2020.1828563>
- Meyers, M. C. (2013). Incidence, mechanisms, and severity of match-related collegiate women's soccer injuries on FieldTurf and natural grass surfaces: A 5-year prospective study. *American Journal of Sports Medicine*, 41(10), 2409-2420. <https://doi.org/10.1177/0363546513498994>
- Modrić, T., Sattler, T., Morgans, R., Pavlinovic, V., & Mandic, A. (2023). Physical performance in highest-level soccer: Comparison between FIFA World Cup and UEFA Champions

- League Matches. *Sport Mont*, 21(2), 3–7.
<https://doi.org/10.26773/SMJ.230701>
- Oliveira, R., Brito, J. P., Martins, A., Mendes, B., Marinho, D. A., Ferraz, R., & Marques, M. C. (2019). In-season internal and external training load quantification of an elite European soccer team. *PloS One*, 14(4), e0209393.
<https://doi.org/10.1371/journal.pone.0209393>
- Padrón-Cabo, A., Rey, E., Vidal, B., & García-Núñez, J. (2018). Work-rate analysis of substitute players in professional soccer: Analysis of seasonal variations. *Journal of Human Kinetics*, 65, 165.
<https://pmc.ncbi.nlm.nih.gov/articles/PMC6341962/>
- Pan, P., Li, F., Han, B., Yuan, B., & Liu, T. (2023). Exploring the impact of professional soccer substitute players on physical and technical performance. *BMC Sports Science, Medicine and Rehabilitation*, 15(1), 143.
<https://doi.org/10.1186/s13102-023-00752-x>
- Pons, E., García-Calvo, T., Resta, R., Blanco, H., López del Campo, R., Díaz García, J., & Pulido, J. J. (2019). A comparison of a GPS device and a multi-camera video technology during official soccer matches: Agreement between systems. *PLoS One*, 14(8), e0220729.
<https://doi.org/10.1371/journal.pone.0220729>
- Rey, E., Lago-Ballesteros, J., & Padrón-Cabo, A. (2015). Timing and tactical analysis of player substitutions in the UEFA Champions League. *International Journal of Performance Analysis in Sport*, 15(3), 840–850.
<https://doi.org/10.1080/24748668.2015.11868835>
- Sampaio, J., & Leite, N. (2013). Performance indicators in game sports. In *Routledge Handbook of Sports Performance Analysis* (pp. 115-126). Routledge.
- Benito Santos, A., Theron, R., Losada, A., Sampaio, J. E., & Lago-Peñas, C. (2018). Data-driven visual performance analysis in soccer: An exploratory prototype. *Frontiers in Psychology*, 9, 2416.
<https://doi.org/10.3389/fpsyg.2018.02416>
- Varley, M. C., Di Salvo, V., Modonutti, M., Gregson, W., & Mendez-Villanueva, A. (2018). The influence of successive matches on match-running performance during an under-23 international soccer tournament: The necessity of individual analysis. *Journal of Sports Sciences*, 36(5), 585–591.
<https://doi.org/10.1080/02640414.2017.1325511>
- Vergonis, A., Michailidis, Y., Mikikis, D., Semaltianou, E., Mavrommatis, G., Christoulas, K., & Metaxas, T. (2019). Technical and tactical analysis of goal scoring patterns in the 2018 FIFA World Cup in Russia. *Facta Universitatis, Series: Physical Education and Sport*, 181-193.
<https://doi.org/10.22190/FUPES190612019V>
- Wang, J., & Zhai, Y. (2025). Association between substitutions and match running performance under five-substitution rule: Evidence from the 2022 FIFA World Cup. *Applied Sciences*, 15(17), 9540.
<https://www.mdpi.com/2076-3417/15/17/9540>
- Wei, X., Zhang, R., Maitiniyazi, A., Chmura, P., Randers, M. B., & Krustup, P. (2024). Running performance of substitutes in the FIFA World Cup after the change in substitution rule: Influence of match outcome, playing position and sex. *International Journal of Performance Analysis in Sport*, 24(6), 666–680.
<https://doi.org/10.1080/24748668.2024.2358268>