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The Comparison of Position-Specific Match Performance between the Group and Knockout Stage of the UEFA Champions League

Ivan Šunjić¹, Šime Veršić¹, Toni Modrić¹, Marin Ćorluka², Petra Zaletel³

¹University of Split, Faculty of Kinesiology, Split, Croatia, ²University of Mostar, Faculty of Science and Education, Mostar, Bosnia and Herzegovina, ³University of Ljubljana, Faculty of Sport, Ljubljana, Slovenia

Abstract

This study aimed to compare match performance in the group and knockout stage of the UEFA Champions League (UCL) for players in different playing positions. The information on physical and technical performances was collected during all UCL matches (n=125) in the 2022/23 season. Players' observations (n=1387) were classified according to their playing positions as central defender (CD; n=471), fullback (FB; n=283), central midfielder (CM; n=376), winger (WM; n=137) and forward (FW; n=104). No differences in technical performance between the group and knockout stage were found for CDs, FBs, CMs, and WMs, while only FWs achieved significantly less shots on target (Cohen's d (d=0.46), total passes (d=0.54), successful passes (d=0.49), and more duels (d=0.39) in the knockout compared to the group stage. The CDs, CMs, and WMs covered greater distance at moderate (d=0.46–0.63) and high (d=0.29–0.38) speeds in the knockout compared to the group stage, while no differences in physical performance between the group and knockout stage were found for FBs and FWs. This study demonstrated that (i) the technical performance of UCL players was in general stable irrespective of the competition stage, (ii) matches played in the knockout stage were characterized by greater match intensity compared to the matches played in the group stage of UCL for CDs, CMs, and WMs. These findings may help football coaches in the decision-making process when selecting the players for specific matches and designing training programs.

Keywords: football, competition stage, playing position, running performance, technical performance

Introduction

Football (soccer) is a team sport with diverse movement patterns and fluctuating dynamics. Consequently, multiple components contribute to successful match performance, with technical, tactical, and physical performance being crucial (Andrzejewski et al., 2022). Physical performance is typically assessed by measuring various kinematic factors such as the total distance, distances covered across different speed zones, and frequency of accelerations (Modric, Versic, Sekulic, & Liposek, 2019). Shots, passes, crosses, and dribbles are commonly utilized metrics for assessing tech-

nical performance (Lorenzo-Martínez, Padrón-Cabo, Rey, & Memmert, 2021), whereas inter-player coordination and inter-team coordination are frequently analyzed to evaluate tactical performance (Memmert, Lemmink, & Sampaio, 2017).

Systematically examining match performance holds great importance as it can be used as a powerful tool (Goes et al., 2021). Specifically, match performance can be used to gain a competitive edge over the opponent, and/or to bring crucial decisions regarding the own team (Sarmiento et al., 2014). However, research investigating match performance



Correspondence:

Toni Modrić
University of Split, Faculty of Kinesiology, Teslina 6, 21 000 Split, Croatia
E-mail: toni.modric@kifst.hr

shows their high variability, hampering their interpretation and application in practice (Oliva-Lozano, Muyor, Fortes, & McLaren, 2021). Empirical evidence demonstrated that myriad factors such as playing position (Modric, Versic, & Sekulic, 2021), match outcome (Chmura et al., 2018) and location (Diana et al., 2017), team formation (Aquino et al., 2020), and opponent quality (Almeida, Ferreira, & Volossovitch, 2014) may affect match performance.

Another factor shown to affect match performance in football is the competition stage (Rampinini, Coutts, Castagna, Sassi, & Impellizzeri, 2007). In general, a competitive season of professional football lasts for 9–10 months. Throughout this period, it is imperative for teams to maintain a stable (i.e., optimal) match performance (Li et al., 2023). However, research repeatedly indicated seasonal variation in match performance (Chmura et al., 2019; Li et al., 2023; Springham, Williams, Waldron, Burgess, & Newton, 2020). Briefly, Springham et al. (2020) investigated the physical performance of English Championship players and reported increased total, high-speed running, and sprinting distances in the first quarter of the season. Chmura et al. (2019) analyzed the physical and technical performance of German Bundesliga players and found that technical performance was similar throughout the season, while physical performance was seasonal dependent. Specifically, the authors reported that total distance reached its peak at two-thirds of the season and subsequently declined until the end. Li et al. (2023) investigated eight consecutive Chinese Super League seasons match performance and reported that physical performance parameters had their peak at the opening and closing matches of the season, while technical performance parameters were relatively stable throughout the season with a substantial increase in the last month.

Although previous studies provided valuable knowledge on changes in match performance according to the competition phase, it is important to note that all of them analyzed teams belonging to only one country (Chmura et al., 2019; Li et al., 2023; Springham et al., 2020). Therefore, the results were undoubtedly influenced by the geographical, cultural, historical, and social aspects of the observed countries (Sapp, Spangenburg, & Hagberg, 2018; Sarmiento et al., 2013). Furthermore, most of these studies observed sub-elite football competitions (i.e., Chinese Super League, 2nd English league) (Li et al., 2023; Springham et al., 2020). To the best of our knowledge, only Chmura et al. presented results obtained from first-division players (Chmura et al., 2019). In addition, only one study considered playing positions (Springham et al., 2020), which hampers “real world” practical applications. Finally, all previous studies were exclusively related to league competitions (Chmura et al., 2019; Li et al., 2023; Springham et al., 2020), while studies to investigate changes in match performance across different competition stages during tournaments are scarce.

The most elite and most prestigious club football competition is the UEFA Champions League (UCL) (Schokkaert & Swinnen, 2014). In the group stage of UCL, thirty-two clubs, divided into eight groups, play six games. Wins earn three points, draws earn one, and losses yield none. Two teams with the most points in each group qualify for the knockout stage, where sixteen teams compete in head-to-head elimination contests. Each pairing involves two matches, with the team scoring more goals over the two games advanc-

ing. Such an elimination format in the knockout stage limits the team's opportunity to fix the mistakes they potentially make, resulting in a more cautious approach to the game plan compared to the group stage. Therefore, differences in match performance across competition phases may be expected.

For all aforementioned reasons, further research analyzing position-specific match performance of elite teams from multiple countries across different competition stages is warranted. The findings from such research may identify whether the match performance depends on the competition stage and provide a benchmark for elite practitioners. Therefore, this study aimed to compare match performance in the group and knockout stage of UCL for players in different playing positions. We hypothesized that both physical and technical performance will be significantly different by group stages.

Methods

Sample and design

Match performances of players were collected from all 125 UCL matches during the 2022/23 season. Of these, 96 matches were played in the group stage and 29 in the knockout stage. Two matches from the group stage were excluded initially due to poor data quality. Only data from players who completed the entire match were analyzed, with goalkeepers excluded due to the unique nature of their position. Consequently, the final dataset comprised 1387 individual match observations from 123 matches involving 437 players from 32 teams. These observations were classified automatically into five positional subsets by the data provider based on the players' tactical role in the team: central defender (CD; $n=471$), fullback (FB; $n=283$), central midfielder (CM; $n=376$), winger (WM; $n=137$) and forward (FW; $n=104$). Players' identities were anonymized following the principles of the Declaration of Helsinki to ensure confidentiality. The investigation was approved by the local university ethics board.

Procedure

Physical performance data were collected using an optical tracking system (Player & Ball Tracking System, Hawk-Eye Innovations Limited, Basingstoke, England). The system's reliability was previously assessed using the official Fédération Internationale de Football Association (FIFA) test protocol for Electronic and Performance Tracking Systems (EPTS). This evaluation involved comparing the data with the Vicon system (Vicon Motion Systems, Oxford Metrics, UK) across five velocity bands (0–7 km/h, 7–15 km/h, 15–20 km/h, 20–25 km/h, and 25+ km/h). The system successfully passed this test protocol (authorization number: 1015068), indicating a high level of reliability. A detailed report is available on the official FIFA webpage. The technical performance data were registered using a WyScout® (Wyscout, Chiavari, Italy) computerized multiple-camera tracking validated analysis tool (Pappalardo et al., 2019a). The procedure of data collection has been previously described in detail (L. Pappalardo et al., 2019b).

Variables

All the physical and technical performance variables with their associated definitions are presented in Table 1.

Table 1. Match performance variables and their definitions.

Physical performance-related variables (m)	
Total distance (TD) (m)	Total distance covered in the match.
Low-intensity running (LIR) (m)	Distance covered at speed <15 km/h.
Moderate-intensity running (MIR) (m)	Distance covered at speed 15–20 km/h.
High-intensity running (HIR) (m)	Distance covered at speed >20 km/h.
Technical performance-related variables (#)	
Goals (#)	A goal scored (does not include own goals).
Assists (#)	The last action of a player from the goalscoring team, prior to the goal being scored by a teammate, or an own goal.
Shots (#)	An attempt to score a goal, made with any (legal) part of the body, either on or off target.
Shots on target (#)	An attempt to score a goal which required intervention to stop the ball going in, or resulted in a shot that would have gone in without diversion.
Passes (#)	A ball sent from one player to another.
Successful passes (#)	An intentionally played ball sent from one player to another that receives the ball.
Crosses (#)	A ball played from the offensive flanks aimed towards a teammate in the area in front of the opponent's goal.
Successful crosses (#)	Completed crosses.
Dribbles (#)	An attempt to move past an opposing player whilst trying to maintain possession of the ball.
Successful dribbles (#)	Completed dribbles.
Duels (#)	A challenge between two players to gain control of the ball, progress with the ball or change its direction.
Successful duels (#)	Completed duels.
Recoveries (#)	Any action that ends a possession of the opposition team (the last action of this possession is a loss) and starts a possession for current team.
Recoveries on opponent half (#)	Recoveries performed on opponent half.
Touches in penalty area (#)	Pass or a touch that happens in the opponent penalty area.
Interceptions (#)	An act of player actively intercepting the ball by anticipating its movement when the opponent is shooting, passing or crossing.
Clearances (#)	An action (generally a pass) when the player, while having other option, to pass or to hold the ball, is instead clearing it, either with a long pass forward without a precise target or for a throw in/corner kick, playing safe.
Sliding tackles (#)	An aggressive slide on the ground in the legs of the opposition player with a clear intention to dispossess the opponent or to clear the ball out.
Successful sliding tackles (#)	Completed sliding tackles.
Key passes (#)	Passes that immediately creates a clear goal scoring opportunity for a teammate.

Statistics

The normality of the distributions was checked by the Kolmogorov – Smirnov test and the descriptive statistics included the means \pm standard deviations. Only TD showed as normally distributed (K-S $p > 0.05$); therefore, later statistical analyses were adapted accordingly. Specifically, one-way analysis of variance was used to compare differences in TD between group and knockout stages, while differences between group and knockout stages in all other variables were examined using nonparametric Mann–Whitney U test. Effect sizes (ES) were evaluated using Cohen's d , and were interpreted as follows: trivial (< 0.2), small (≥ 0.2 – 0.5), moderate (≥ 0.5 – 0.8), and large (> 0.8) (Cohen, 2013). All the analyses were performed using Statistica v.14.0.1.25 (TIBCO Software

Inc, USA), and the significance level was set to $p < 0.05$.

Results

Table 2 presents descriptive statistics and differences in CMs' physical and technical performance in the group and knockout stage of UCL. CDs covered less MIR (small ES) and HIR (small ES) in the group stage compared to the knockout stage. No differences in TD and LIR were found irrespective of the competition stages. Also, CDs' technical performance was similar both in the group and knockout stages (all trivial-to-small ES).

Table 3 presents descriptive statistics and differences in FBs' physical and technical performance in the group and knockout stage of UCL. No differences in both physical and technical performance were found irrespective of playing in

Table 2. Central defenders' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Physical performance-related variables (m)					
Total distance*	10219.4±742.3	10298.3±745.3	-1.00	0.32	-0.11 (-0.31 – 0.1)
Low-intensity running	8313.7±543.3	8121.5±839	1.66	0.1	0.31 (0.1 – 0.51)
Moderate-intensity running	1291.6±275.5	1509.9±830	-2.29	0.02	-0.46 (-0.67 – -0.25)
High-intensity running	614.1±184.5	666.9±165.8	-3.33	<0.01	-0.29 (-0.5 – -0.08)
Technical performance-related variables (#)					
Goals	0.1±0.2	0±0.2	0.36	0.72	0.11 (-0.1 – 0.32)
Assists	0±0.2	0±0	0.59	0.55	0.22 (0.01 – 0.43)
Shots	0.4±0.8	0.4±0.7	-0.39	0.7	0 (-0.21 – 0.2)
Shots on target	0.2±0.4	0.2±0.4	-0.27	0.79	-0.02 (-0.22 – 0.19)
Passes	55.9±22.3	56.1±21.2	0.02	0.98	-0.01 (-0.21 – 0.2)
Successful passes	50.3±22.2	51±20.8	-0.35	0.73	-0.03 (-0.24 – 0.18)
Crosses	0.4±1.1	0.2±0.7	0.56	0.57	0.15 (-0.06 – 0.36)
Successful crosses	0.1±0.5	0.1±0.4	0.89	0.37	0.15 (-0.06 – 0.35)
Dribbles	0.8±1.5	0.5±0.7	1.43	0.15	0.26 (0.05 – 0.47)
Successful dribbles	0.5±1	0.2±0.5	1.88	0.06	0.3 (0.09 – 0.5)
Duels	13.2±5.9	13.7±5.8	-0.69	0.49	-0.08 (-0.29 – 0.13)
Successful duels	7.7±3.9	8.2±3.9	-0.94	0.35	-0.12 (-0.33 – 0.09)
Recoveries	10.3±4.2	10.8±3.7	-1.26	0.21	-0.13 (-0.34 – 0.08)
Recoveries on opponent half	2.1±1.9	2.1±1.7	-0.58	0.57	-0.01 (-0.22 – 0.2)
Touches in penalty area	0.6±1.1	0.6±0.9	-0.2	0.84	0.04 (-0.17 – 0.25)
Interceptions	5.2±2.8	4.9±2.4	1.02	0.31	0.11 (-0.09 – 0.32)
Clearances	2.5±2.1	2.7±2	-1.37	0.17	-0.12 (-0.32 – 0.09)
Sliding tackles	0.3±0.6	0.3±0.7	0.12	0.91	-0.02 (-0.23 – 0.18)
Successful sliding tackles	0.2±0.4	0.2±0.5	-0.18	0.86	-0.03 (-0.24 – 0.18)
Key passes	0.1±0.4	0.1±0.3	0.27	0.79	0.08 (-0.13 – 0.28)

* denotes variables where T-test was calculated; MW - Mann-Whitney U test; CI – confidence interval.

Table 3. Fullbacks' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Physical performance-related variables (m)					
Total distance*	10899.3±722.8	10885.5±671.4	0.13	0.89	0.02 (-0.27 – 0.3)
Low-intensity running	8343.9±501.7	8216.6±590.7	1.62	0.1	0.24 (-0.04 – 0.53)
Moderate-intensity running	1540.5±263.6	1616.1±476.4	-0.48	0.63	-0.24 (-0.52 – 0.05)
High-intensity running	1014.9±233.2	1052.8±186.8	-1.39	0.17	-0.17 (-0.45 – 0.12)
Technical performance-related variables (#)					
Goals	0±0.2	0±0.2	0.19	0.85	0.08 (-0.21 – 0.36)
Assists	0.1±0.3	0.1±0.3	0.43	0.67	0.13 (-0.16 – 0.42)
Shots	0.7±1	0.7±1	0.36	0.72	0.04 (-0.25 – 0.32)
Shots on target	0.2±0.5	0.3±0.5	-0.34	0.73	-0.08 (-0.37 – 0.2)
Passes	48.8±17.7	47.2±18.8	0.46	0.65	0.09 (-0.19 – 0.38)
Successful passes	40.7±17.4	38.9±16.9	0.46	0.65	0.1 (-0.18 – 0.39)
Crosses	2.6±2.5	2.5±1.9	-0.37	0.71	0.04 (-0.25 – 0.32)
Successful crosses	0.8±1.1	0.8±0.9	-0.11	0.91	0.04 (-0.24 – 0.33)
Dribbles	2.6±2.7	2.5±2.5	-0.31	0.76	0.02 (-0.27 – 0.3)

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Table 3. Fullbacks' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Successful dribbles	1.3±1.7	1.5±1.6	-1.01	0.31	-0.09 (-0.38 – 0.19)
Duels	17.3±6.2	18.6±6	-1.43	0.15	-0.21 (-0.49 – 0.08)
Successful duels	8.8±3.9	9.4±3.9	-1.07	0.29	-0.16 (-0.44 – 0.13)
Recoveries	8.7±3.9	8.8±3	-0.8	0.42	-0.02 (-0.31 – 0.26)
Recoveries on opponent half	2.7±2.1	2.8±1.8	-0.82	0.41	-0.07 (-0.35 – 0.22)
Touches in penalty area	1.3±1.5	1.6±1.6	-1.44	0.15	-0.2 (-0.48 – 0.09)
Interceptions	4.8±2.6	4.8±2.3	-0.17	0.86	-0.01 (-0.3 – 0.27)
Clearances	1.7±1.6	2.3±2	-2.12	0.03	-0.35 (-0.63 – -0.06)
Sliding tackles	0.4±0.7	0.4±0.7	-0.47	0.64	-0.05 (-0.33 – 0.24)
Successful sliding tackles	0.2±0.4	0.2±0.4	-0.22	0.82	-0.03 (-0.32 – 0.25)
Key passes	0.4±0.7	0.4±0.7	0.28	0.78	0.05 (-0.24 – 0.33)

* denotes variables where T-test was calculated; MW - Mann-Whitney U test; CI – confidence interval.

the group or knockout stage (all trivial-to-small ES) for FBs.

Table 4 presents descriptive statistics and differences in CMs' physical and technical performance in the group and

knockout stage of UCL. CMs covered less MIR (medium ES) and HIR (small ES) in the group compared to the knockout stage. In addition, in the group stage, CMs performed more

Table 4. Central midfielders' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Physical performance-related variables (m)					
Total distance*	11728.2±729.9	11863.5±830.1	-1.56	0.12	-0.18 (-0.4 – 0.05)
Low-intensity running	8899.3±484.8	8634.1±864.5	2.68	0.01	0.43 (0.2 – 0.66)
Moderate-intensity running	1977±405.1	2295.8±876.7	-3.55	<0.01	-0.55 (-0.78 – -0.32)
High-intensity running	851.9±249.4	933.6±194.2	-3.5	<0.01	-0.35 (-0.57 – -0.12)
Technical performance-related variables (#)					
Goals	0.1±0.3	0.1±0.3	0.1	0.92	0.02 (-0.2 – 0.25)
Assists	0.1±0.3	0±0.2	0.45	0.65	0.13 (-0.09 – 0.35)
Shots	1±1.3	1.1±1.2	-0.88	0.38	-0.04 (-0.27 – 0.18)
Shots on target	0.3±0.6	0.3±0.6	0	1	0.03 (-0.2 – 0.25)
Passes	50.3±19.7	50.5±18	-0.28	0.78	-0.01 (-0.23 – 0.22)
Successful passes	44.2±19.6	45.1±17.6	-0.63	0.53	-0.05 (-0.27 – 0.18)
Crosses	0.8±1.3	0.9±1.5	-0.92	0.36	-0.07 (-0.3 – 0.15)
Successful crosses	0.3±0.6	0.3±0.7	-0.62	0.53	-0.12 (-0.35 – 0.1)
Dribbles	1.6±1.7	2±2.1	-1.38	0.17	-0.21 (-0.43 – 0.02)
Successful dribbles	0.9±1.2	1.2±1.4	-1.23	0.22	-0.19 (-0.41 – 0.04)
Duels	16.6±6	17.2±6.4	-0.94	0.35	-0.11 (-0.34 – 0.11)
Successful duels	8.4±3.5	8.6±3.9	-0.21	0.83	-0.06 (-0.28 – 0.17)
Recoveries	8.7±3.9	8.3±4	0.83	0.41	0.09 (-0.13 – 0.32)
Recoveries on opponent half	3.5±2.3	3.4±2.3	0.15	0.88	0.02 (-0.2 – 0.25)
Touches in penalty area	1.2±1.7	1.2±1.5	-0.32	0.75	0 (-0.22 – 0.22)
Interceptions	4.4±2.7	4±2.5	1.17	0.24	0.16 (-0.06 – 0.39)
Clearances	1±1.4	1.1±1.4	-0.7	0.48	-0.08 (-0.3 – 0.15)
Sliding tackles	0.5±0.8	0.6±1	-0.08	0.94	-0.07 (-0.3 – 0.15)
Successful sliding tackles	0.2±0.5	0.3±0.8	-0.16	0.87	-0.12 (-0.35 – 0.1)
Key passes	0.3±0.6	0.3±0.6	-0.43	0.67	-0.02 (-0.24 – 0.21)

* denotes variables where T-test was calculated; MW - Mann-Whitney U test; CI – confidence interval.

LIR (small ES) compared to the knockout stage. CMs' technical performance was similar both in the group and knockout stages (all trivial-to-small ES).

Table 5 presents descriptive statistics and differences in WMs' physical and technical performance in the group and knockout stage of UCL. WMs covered less MIR (medium ES) and HIR (small ES) in the group stage compared to the

knockout stage. Also, in the group stage, WMs performed more LIR (small ES) compared to the knockout stage. In addition, WMs in the group stage had less successful dribbles (small ES) than in the knockout stage, while no differences in all other technical performance variables were found irrespective of the competition stages (all trivial-to-small ES).

Table 5. Wide midfielders' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Physical performance-related variables (m)					
Total distance*	11126.6±933.8	11093.9±1050.2	0.18	0.85	0.03 (-0.33 – 0.39)
Low-intensity running	8411.6±611	7903.8±1042.3	2.86	<0.01	0.66 (0.29 – 1.02)
Moderate-intensity running	1678.8±380.4	2062.9±941.9	-2.12	0.03	-0.63 (-0.99 – -0.26)
High-intensity running	1036.2±231.8	1127.2±260.2	-2.06	0.04	-0.38 (-0.74 – -0.01)
Technical performance-related variables (#)					
Goals	0.3±0.5	0.2±0.5	1.2	0.23	0.23 (-0.13 – 0.59)
Assists	0.2±0.5	0.1±0.4	0.45	0.65	0.18 (-0.18 – 0.53)
Shots	2.1±2	1.6±1.5	1.03	0.3	0.25 (-0.11 – 0.61)
Shots on target	0.9±1.2	0.7±0.9	0.68	0.5	0.19 (-0.17 – 0.55)
Passes	38.8±17.5	38.5±12.6	-0.48	0.63	0.02 (-0.34 – 0.38)
Successful passes	32.4±16.5	31.7±11.5	-0.37	0.71	0.04 (-0.32 – 0.4)
Crosses	2±2.5	2.2±1.6	-1.39	0.16	-0.08 (-0.43 – 0.28)
Successful crosses	0.7±1	0.6±0.8	0.43	0.67	0.14 (-0.22 – 0.5)
Dribbles	4.3±3.8	5.2±3.8	-1.73	0.08	-0.25 (-0.6 – 0.12)
Successful dribbles	2.4±2.3	3±2.3	-2.12	0.03	-0.29 (-0.65 – 0.07)
Duels	19.8±6.6	21.6±6.7	-1.59	0.11	-0.27 (-0.63 – 0.09)
Successful duels	9.1±3.8	9±3.6	0	1	0.01 (-0.35 – 0.37)
Recoveries	5.1±3.3	4.8±2.7	0.17	0.87	0.1 (-0.26 – 0.46)
Recoveries on opponent half	2.3±1.5	2.9±2	-1.41	0.16	-0.32 (-0.68 – 0.05)
Touches in penalty area	3.3±3.1	3.5±2.4	-1.48	0.14	-0.1 (-0.45 – 0.26)
Interceptions	2.7±2.5	2.7±1.8	-1.01	0.31	-0.02 (-0.38 – 0.34)
Clearances	0.7±1.3	0.7±0.9	-0.79	0.43	0.04 (-0.31 – 0.4)
Sliding tackles	0.2±0.4	0.4±0.8	-1.05	0.29	-0.43 (-0.79 – -0.06)
Successful sliding tackles	0.1±0.3	0.2±0.5	-0.77	0.44	-0.26 (-0.62 – 0.1)
Key passes	0.8±1	0.7±0.7	-0.08	0.94	0.11 (-0.25 – 0.47)

* denotes variables where T-test was calculated; MW - Mann-Whitney U test; CI - confidence interval.

Table 6 presents descriptive statistics and differences in FWs' physical and technical performance in the group and knockout stage of UCL. No differences in physical perfor-

mance were found irrespective of playing in group or knockout stage (all trivial-to-small ES) for FWs. However, FWs in the group stage executed more shots on target (small ES), passes

Table 6. Forwards' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance	p	Effect size
	Mean±SD	Mean±SD	T/MW-test		Cohen's d (95%CI)
Physical performance-related variables (m)					
Total distance*	10586.4±1108.2	10549±1233.7	0.15	0.88	0.03 (-0.39 – 0.46)
Low-intensity running	8294.2±725.1	8037.7±868.5	1.33	0.18	0.33 (-0.09 – 0.76)
Moderate-intensity running	1431.8±388.4	1583.8±814.1	-0.4	0.69	-0.28 (-0.7 – 0.15)
High-intensity running	860.4±262.6	927.5±244.9	-1.09	0.27	-0.26 (-0.68 – 0.17)

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Table 6. Forwards' match performance in different competition stages of UEFA Champions League.

	Group stage	Knockout stage	Analysis of variance		Effect size
	Mean±SD	Mean±SD	T/MW-test	p	Cohen's d (95%CI)
Technical performance-related variables (#)					
Goals	0.5±0.7	0.2±0.5	1.78	0.08	0.45 (0.02 – 0.88)
Assists	0.2±0.5	0.1±0.3	0.76	0.45	0.3 (-0.12 – 0.73)
Shots	2.7±2	2.3±1.3	0.6	0.55	0.23 (-0.2 – 0.65)
Shots on target	1.3±1.1	0.8±0.9	2	0.05	0.46 (0.03 – 0.88)
Passes	30.6±15.3	22.9±12.2	2.49	0.01	0.54 (0.1 – 0.96)
Successful passes	24.7±14	18.3±10.9	2.34	0.02	0.49 (0.06 – 0.91)
Crosses	1.1±1.4	0.7±1	1.33	0.18	0.33 (-0.1 – 0.75)
Successful crosses	0.3±0.5	0.2±0.6	0.41	0.68	0.06 (-0.36 – 0.48)
Dribbles	2.6±2.7	2.6±2.6	0	1	0.02 (-0.41 – 0.44)
Successful dribbles	1.4±1.7	1.1±1.3	0.99	0.32	0.22 (-0.2 – 0.64)
Duels	18.8±9	22.2±7.1	-2.46	0.01	-0.39 (-0.82 – 0.04)
Successful duels	7.7±4	8.4±4	-1.11	0.27	-0.19 (-0.61 – 0.24)
Recoveries	3.7±3.3	2.9±1.7	0.34	0.73	0.27 (-0.15 – 0.7)
Recoveries on opponent half	2.1±1.5	1.8±1.3	0.49	0.62	0.18 (-0.25 – 0.6)
Touches in penalty area	4.2±3	3.8±2.1	0.31	0.75	0.14 (-0.28 – 0.57)
Interceptions	2±2.3	1.9±1.5	-0.33	0.74	0.06 (-0.36 – 0.48)
Clearances	0.5±1	0.8±1	-1.23	0.22	-0.24 (-0.66 – 0.19)
Sliding tackles	0.3±0.9	0.2±0.4	0.03	0.97	0.16 (-0.26 – 0.59)
Successful sliding tackles	0.1±0.5	0.1±0.3	0.08	0.93	0.11 (-0.31 – 0.53)
Key passes	0.7±1	0.4±0.5	0.83	0.41	0.32 (-0.11 – 0.75)

* denotes variables where T-test was calculated; MW - Mann-Whitney U test; CI - confidence interval.

(medium ES), and successful passes (small ES) compared to the knockout stage. Also, less duels (small ES) were performed by FWs in the group compared to the knockout stage. All other technical performance variables for FWs were similar irrespective of the competition stages (all trivial-to-small ES).

Discussion

This study aimed to compare match performance in the group and knockout stage of UCL for players in different playing positions. The main results were that (i) the technical performance of all players was consistent across both stages of the competition, except for FWs who achieved less shots on target, total and successful passes, and more duels in the knockout compared to the group stage, (ii) CDs, CMs, and WMs covered significantly more MIR and HIR in the knockout compared to the group stage, while FBs' and FWs' physical performance were similar irrespective the competition stage. Considering evident position-specific changes, the hypothesis that both physical and technical performance will be significantly different by group stages was partially accepted.

Representing the overall amount of space covered throughout the match, TD is one of the most common variables used to assess physical performance in football (Modric et al., 2019). Previous research investigating TD through the various competition stages reported diverse results. Briefly, Chmura et al. showed that the average TD had the highest value at two-thirds of the season in the German Bundesliga (Chmura et al., 2019), while Li et al. indicated that average TD in the Chinese Super League reached its peak in the initial and fi-

nal fixtures (Li et al., 2023). In contrast, our results showed no significant difference in TD irrespective of the competition phase of UCL, indicating similar overall running efforts in the group and knockout stage of most elite football players in all playing positions. The possible explanation for such inconsistent findings compared to previous studies (Chmura et al., 2019; Li et al., 2023) may be a different concept of football competition analyzed (De Albuquerque Freire et al., 2022). While previous studies analyzed match performance in league type of competition (Chmura et al., 2019; Li et al., 2023), the current study analyzed tournament type of competition. In such competitions, the later (i.e., knockout) stage consists of higher-quality teams compared to the earlier (i.e., group) stage which consists of lower-quality teams. However, in UCL, both greater and lower-quality teams typically demonstrate similar TD (Modric et al., 2023), possibly explaining their similar TD in both group and knockout stages.

Arguably some of the crucial running performance indicators in football are MIR and HIR because of its relationship with match outcome (Chmura et al., 2018) and situational efficacy (Modric et al., 2019), respectively. The research investigating these metrics across various competition stages remained equivocal. For example, Chmura et al. indicated the lowest MIR and HIR values during the initial and final fixtures (Chmura et al., 2019). However, Li et al. reported gradually increased MIR and HIR in the final periods of the Chinese Super League (Li et al., 2023). Despite the different concepts of football competitions, to some extent, our results can be comparable to the results from the study of Li et al.

who highlighted increased physical performance in later competition stages. Specifically, our results showed significantly greater MIR and HIR in the knockout (i.e., the later stage of the season) compared to the group (i.e., earlier stage of the season) for CDs, CMs, and WMs (all small to medium ES). Although it did not reach statistical significance, our descriptive parameters show a similar trend among FWs and FBs as well, suggesting heightened match intensity in the knockout stage for all players. Due to the higher standard of teams competing in the UCL knockout stage (i.e., as discussed previously), it is possible that players performed more attacking actions in the knockout than in the group stage. Since attacking actions are related to intensive efforts (Andrzejewski, Chmura, Konefał, Kowalczyk, & Chmura, 2017; Di Salvo, Gregson, Atkinson, Tordoff, & Drust, 2009; Modric et al., 2023), it may explain greater physical performance at moderate and higher speeds (i.e., MIR and HIR).

Irrespective of causality, it is evident that achieving the football match-play level required in the knockout stage of UCL might not be possible without a high level of physical performance at moderate and higher speeds (Mackenzie & Cushion, 2013). However, for competitive success in football, players' technical performance is decisive (Moalla et al., 2018; Modric, Versic, & Jelcic, 2022). As teams promoted to the knockout stage can be characterized as more successful compared to those not promoted from the group stage, it is expected that players from teams playing in the knockout stage will achieve increased technical performance. However, our results showed no significant differences in technical performance irrespective of playing either in the group or knockout stage for almost all players. Specifically, all CDs', FBs', CMs', and WMs' technical performance variables were similar both in the group and knockout stage of UCL. Such findings are generally in line with previous studies which demonstrated weak differences in technical performance in various competition stages (Chmura et al., 2019; Li et al., 2023). Therefore it seems that the technical performance of top-elite football players (i.e., those playing in UCL) was at a high level irrespective of the competition stage, indicating the importance of players' technical proficiency throughout the whole season.

However, it is noteworthy that the technical performance of top-elite FWs was dependent on the competition stage. Specifically, our results showed that FWs had more duels and less shots on target, total, and successful passes in the knockout stage. This may be a consequence of their playing against higher-standard defenders in the knockout stage. In general, defenders' main match duty is to prevent the opponent's attacks on their goal (Modric et al., 2019). To complete this efficiently, defenders keep close to the opposing players, most often to the FWs', disabling them from receiving the ball and performing passes and/or shots. Due to the increased standard of teams competing in the UCL knockout stage (i.e., as discussed previously), it is possible that defenders from the knockout stage were more efficient in these duties. As a consequence, FWs in knockout stage matches likely needed to

be more active to achieve their good positioning, which may explain their increased number of duels. For the same reason (i.e., playing against higher-standard defenders), FWs in the knockout stage had less opportunities to receive the ball than in the group stage matches, resulting in their decreased shots on target, total, and successful passes.

Several limitations should be noted when interpreting the findings of this study. Firstly, the influence of contextual factors that can affect match performance (Jerkovic, Modric, & Versic, 2022), such as the quality of the opponent, match outcome, and location, were not considered. However, as previous research indicated the weak effect of these factors on match performance in UCL (Modric et al., 2023), the influence on match performance in the current study may be negligible. Secondly, match observations for group and knockout stage matches were unequal in their sample sizes, and such discrepancy likely influenced the findings. Thirdly, for methodological reasons, we included only players who played a whole match, which reduced the number of observations and may have affected match performance. Further studies with longitudinal designs that control for contextual factors are necessary to confirm the present results. Finally, for a more detailed understanding of position-specific match performance in different competition stages, there should be some attempt to perform a deeper analysis of playing positions; for example, splitting the CMs into the defensive, central, and offensive midfielders.

This research suggests two main practical applications. Firstly, the results revealed that the technical performance of UCL players was in general similar irrespective of the competition stage. As UCL is the highest-level football competition consisting of the world-best football players whose technical performance is certainly on a high level (Modric et al., 2023), such findings suggest that the technical proficiency of UCL players was on the highest possible level both in the group and knockout stages. Therefore, participation in UCL, even in the group stage, requires technical high-skilled players. This information may be of great help to the football coaches in the decision-making process when selecting the players for specific matches during the whole competitive season. Secondly, our results indicated that CDs, CMs, and WMs covered more MIR and HIR in the knockout stage than in the group stage of UCL. Considering their similar TD irrespective of the competition stage but greater distance covered at higher speeds, such findings suggest that for CDs, CMs, and WMs matches played in the knockout stage were characterized by greater match intensity compared to the matches played in the group stage of UCL. Therefore, physical conditioning programs preceding matches of the knockout stage for these players should be designed to enable them to respond to these needs. In addition, considering their increased HIR, which may be associated with greater fatigue, football coaches should consider extended periods of recovery or supplementary practices (e.g., ice submersions, massage, etc.) following matches of the knockout stage.

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Conflict of Interest

The authors report no conflict of interest.

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