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ORIGINAL SCIENTIFIC PAPER

Physical Performance in Highest-Level Soccer: Comparison between FIFA World Cup and UEFA Champions League Matches

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Abstract

Match running performance (RP) of Union of European Football Associations Champions League (UCL) and Fédération Internationale De Football Association World Cup (WC) players are often investigated separately; however, no study to simultaneously observed RP in both competitions. Therefore, the main objective of this study was to provide a comparative analysis of RP of professional soccer match-play across two highest-level soccer competitions: UCL and WC. The RPs (UCL; n=244, WC; n=581) of professional soccer players were analyzed using optical systems, and classified according to their playing positions as: central defenders (CD), fullbacks (FB), central midfielders (CM), wide midfielders (WM) and forward (FW). The RP variables included total distance and high intensity running (>5.5 m/s). One-way analysis of variance was used to examine position-specific differences between RP in WC and UCL, while Cohen's d was used to identify effect sizes. Results indicated that CDs, FBs, CMs, and WMs from UCL covered significantly greater total distance than their counterparts from WC (all moderate effect sizes). In addition, CDs from UCL achieved greater amount of high intensity running than CDs from WC (small effect size). This study demonstrated differences in various aspects of physical performance between two highest-level soccer competitions with variations dependent upon playing position. The findings enabled a more thorough understanding of the physical requirements for playing in UCL and WC, and may have direct consequences for specific training programs.

Keywords: match analysis, football, running performance, comparative analysis, playing positions

Introduction

The application and use of technology in soccer has grown exponentially in recent years, allowing practitioners and researchers to evaluate the physical demands of competitive match play (Doncaster, Page, White, Svenson, & Twist, 2020). The most common technique to evaluate physical demands in soccer is analysis of players' running performance (RP) such as total distance and high intensity running (Pranjic, Modric, & Uljevic, 2022). Detailed knowledge on these metrics is useful when determining performance profiles and designing sport-specific training programs which is vital to optimize soccer performance (Carling, 2011). For example, total dis-

tance and high intensity running distance covered by players in a match can be used to prescribe more specific training or to consider new ways to improve the efficiency of team training (Modric, Versic, Morgans, & Sekulic, 2023).

Studies have demonstrated that players can cover between 9 and 14 km during the matches, performing 5–15% of that distance in high intensity running (Modric, Versic, & Sekulic, 2021; De Albuquerque Freire et al., 2022). This wide ranges are determined by different variables that are associated with running performance (Jerkovic, Modric, & Versic, 2022), but primarily with playing positions due to the players' specific roles during the match (Di Salvo et al., 2007). Thus, midfielders are



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responsible for the connection between defense and attack, and such role require them to achieve greater total distance compared to the players on other playing positions (Modric, Versic, Sekulic, & Liposek, 2019). On the other hand, side players (e.g., fullbacks and wingers) cover the greatest distances in high intensity running due to their frequent involvement in attacking activities (Bradley et al., 2009). Accordingly, the position-specific load needs to be taken into consideration when designing and implementing training programs (Baptista, Johansen, Figueiredo, Rebelo, & Pettersen, 2020).

Soccer is no doubt one of the most popular sports in the world, played in more than 200 countries (Milanović, Pantelić, Čović, Sporiš, & Krustup, 2015). The highest-level soccer competitions in soccer are Union of European Football Associations Champions League (UCL) and Fédération Internationale De Football Association World Cup (WC) (Tuo, Wang, Huang, Zhang, & Liu, 2019; Modric et al., 2023). Analyzing the RP of players' competing in such competitions may help to constitute activity profiles which can be used by coaches and players for achieving the most elite game-play. Therefore, it is not surprising that in recent years, researchers have put forth great efforts to provide knowledge on the RP of UCL and WC players and factors influencing RP (Bradley, Dellal, Mohr, Castellano, & Wilkie, 2014; Miñano-Espin, Casáis, Lago-Peñas, & Gómez-Ruano, 2017; Tuo et al., 2019; Yi et al., 2019; Modric et al., 2022).

In brief, Minano-Espin et al. analyzed the high intensity running patterns of UCL players according to the quality of the opposition (Miñano-Espin et al., 2017). Modric et al. recently analyzed factors affecting RP of UCL players (Modric et al., 2022), while Bradley et al.'s focus was on the gender differences of UCL players (Bradley et al., 2014). Regarding the RP of WC players, Tuo et al. quantified the differences during the matches from different continental confederations (Tuo et al., 2019), while Yi et al. investigated the effect of playing styles on the RP of WC (Yi et al., 2019).

Evidently, RP of UCL and WC players are often investigated separately. However, to the best of our knowledge, there is no study that simultaneously observed RP in both competitions. A direct comparison of RP between competitions would be useful in determining whether physical performance is general to all highest-level competitions or if each competition has its own specific playing characteristics (Dellal et al., 2011). The findings may help soccer practitioners to tailor position-specific training programs that are suitable for each respective competition (Aquino et al., 2017). Therefore, the main objective of this study was to provide a comparative analysis of RP of professional soccer match-play across two highest-level soccer competitions: UCL and WC.

Methods

Design and sample

The RPs of players competing in UCL were analysed in 20 randomly selected matches played in group stage. The RPs of players competing in WC were analysed in all matches played both in group stage and knock-out stage (n=64). Due to the methodological reasons, matches that included a player dismissal (red card) or extra times were excluded from analysis. This resulted in excluding 9 matches from WC, while no matches from UCL have been excluded from initial sample. Therefore, 55 matches from WC and 20 from UCL were included for final analysis. As suggested previously, only the RPs

of those players who participated in entire matches were analyzed (Lorenzo-Martinez et al., 2021), resulting in retrieval of 244 RPs from UCL and 581 RPs from WC which were included as cases in this study. The RPs were classified automatically into five positional subsets by the data provider based on the players' role in the team as: central defenders (CD; n=300), fullbacks (FB; n=189), central midfielders (CM; n=195), wide midfielders (WM; n=87) and forward (FW; n=54). Players' identities were anonymized in accordance with the principles of the Declaration of Helsinki to ensure confidentiality. The investigation was approved by the Faculty of Kinesiology, University of Split (approval number: 2181-205-02-05-19-0020, 1 September 2019).

Procedures

The RP in UCL matches were collected using an optical system InStat Fitness (Instat Limited, Limerick, Republic of Ireland) with a sampling frequency of 25 Hz. The reliability of this system has been demonstrated, as the system has passed the official Fédération Internationale de Football Association (FIFA) test protocol for Electronic & Performance Tracking Systems (EPTS). The RP from WC matches were provided by official FIFA Football Data Ecosystem (publicly available on FIFA webpage: <https://www.fifatrainingcentre.com/en/fwc2022/post-match-summaries/post-match-summary-reports.php>), a complex network consisting of several optical systems. All optical systems included in this network operate at 25Hz and have the same threshold values for high intensity running (i.e., variable included in this study) as InStat Fitness does. Moreover, all of them have passed the same test protocol for EPTS as InStat Fitness does. This confirms quality of data from WC matches and justify usage in current study. The RPs variables included total distance covered (m) and high intensity running (m) (>5.5 m/s).

Statistical Analyses

The Kolmogorov-Smirnov test revealed that all data were normally distributed (all K-S $p > 0.05$). Homogeneity was evaluated using Levene's test, and data are presented as means \pm standard deviations. One-way analysis of variance (ANOVA) was used to examine position-specific differences between RP in WC and UCL. Cohen's d was used to identify effect sizes (ES) and interpreted as follows: trivial (<0.2), small ($\geq 0.2-0.5$), moderate ($\geq 0.5-0.8$) and large (>0.8) (Cohen, 2013). For all analyses, SPSS software Version 25 (IBM, Armonk, NY, USA) was used, and $p < 0.05$ was considered statistically significant.

Results

Table 1 and 2 present descriptive statistics and differences for total distance and high intensity running during the WC and UCL matches according to the soccer-specific playing positions. Results indicated that CDs, FBs, CMs, and WMs from UCL (10201 m, 10903 m, 11880 m, and 11129 m, respectively) covered significantly greater total distance ($f=22.07, 14.52, 11.03, \text{ and } 6.36$, respectively; all $p=0.01$, all moderate ES) than their counterparts from WC (9762 m, 10482 m, 11434 m, and 10547 m). In addition, CDs from UCL achieved greater amount of high intensity running than CDs from WC (638 m and 585 m, respectively; $f=4.58, p=0.03$, small ES). No differences between FWs' total distance covered ($f=0.05, p > 0.05$) and high intensity running ($f=0.40, p > 0.05$) in UCL and WC were found.

Table 1. Descriptive statistics for total distance and high intensity running during the World Cup and UEFA Champions League matches according to the soccer-specific playing positions.

		World Cup	UEFA Champions League
		Mean±SD	Mean±SD
Central defenders	TD (m)	9762±715	10201±704
	HIR (m)	585±181	638±207
Fullbacks	TD (m)	10482±722	10903±722
	HIR (m)	1005±250	1017±230
Central midfielders	TD (m)	11434±917	11880±615
	HIR (m)	843±267	914±263
Wide midfielders	TD (m)	10547±1116	11129±714
	HIR (m)	1034±230	1098±195
Forwards	TD (m)	10421±971	10479±793
	HIR (m)	849±294	900±242

TD – total distance, HIR – high intensity running

Table 2. Comparison of for total distance and high intensity running during the World Cup and UEFA Champions League matches according to the soccer-specific playing positions.

		ANOVA			Effect size
		MD	f	p	Cohen's d (95% CI)
Central defenders	TD	-439	22.07	0.01	-0.62 (-0.88; -0.35)
	HIR	-53	4.58	0.03	-0.28 (-0.54; -0.02)
Fullbacks	TD	-421	14.52	0.01	-0.58 (-0.89; -0.28)
	HIR	-12	0.10	0.75	-0.05 (-0.35; 0.25)
Central midfielders	TD	-446	11.03	0.01	-0.53 (-0.84; -0.21)
	HIR	-71	2.81	0.10	-0.27 (-0.58; 0.05)
Wide midfielders	TD	-582	6.36	0.01	-0.58 (-1.03; -0.12)
	HIR	-65	1.65	0.20	-0.29 (-0.74; 0.16)
Forwards	TD	-58	0.05	0.83	-0.06 (-0.64; 0.51)
	HIR	-52	0.40	0.53	-0.19 (-0.76; 0.39)

TD – total distance, HIR – high intensity running; MD – mean difference, CI – confidence interval

Discussion

This study aimed to provide a comparative analysis of RP of professional soccer match-play across two highest-level soccer competitions: UCL and WC. Results demonstrate that specific physical performance exist in the two highest-level soccer competitions and notably across individual positional roles. These findings may contribute to the prescription of individualized training and preparation strategies.

The various demands of elite soccer performance have been frequently described in the scientific literature (Sarmiento et al., 2014; Petrov, Michaelides, & Parpa, 2022). However, there is a lack of studies attempting to address differences in physical match performance especially between highest-level soccer competitions while using the same method of analysis and definitions of movement speed (Dellal et al., 2011). Current study therefore aimed to fulfil this research gap. Our results indicated significant differences in total distance covered during the UCL and WC for players on almost all playing positions. Specifically, while no significant differences between FWs' total distance covered in UCL and WC were found, greater total distance in UCL compared to WC was evidenced for CDs (10201 m and 9762 m, respectively), FBs (10903 m and 10482 m, respectively), CMs (11880 m and 11434 m, re-

spectively), and WMs (11129 m and 10547 m, respectively). Because total distance is an accepted indicator of the overall physical demands during competition in soccer (Rey, Costa, & Corredoira, 2019), it is possible that playing in UCL presents a greater degree of physical demand for defensive (e.g., CDs and FBs) and midfield players (e.g., CMs and WMs) than for offensive players (e.g., FWs).

It is especially important to emphasize significant differences in high intensity running during the UCL and WC for CDs. Specifically, CDs playing in UCL (638 m) achieved greater high intensity running distance than CDs playing in WC (585 m). We may speculate that CDs in UCL were more involved in offensive actions than their peers in WC. Given that this requires their deeper positioning in the opponent's half of the pitch, they consequently leave larger spaces behind their backs. Considering that after losing ball in the attack phase, a rapid offensive transition by the opposing team regularly followed (Hewitt, Greenham, & Norton, 2016), CDs should utilize higher running speeds to outperform opponent players and successfully defend this space (Modric et al., 2023). This may explain their increased high intensity running distance when playing in UCL. Irrespective of causality, since high intensity running distance has been suggested to be a specific

measure of physical performance due to its relationship with training status (Bradley et al., 2009; Rey et al., 2019), CDs' increased high intensity running distance in UCL indicates that playing in UCL may be physical more demanding for them than playing in WC.

The data on match physical performance in general aid soccer coaches and practitioners in decision making processes for structuring the elements of training (Aquino et al., 2017). Thus, evident differences in physical performances in UCL and WC matches examined in current study suggest that the same training programs are not suitable for both UCL and WC irrespective the fact that both can be considered as highest-level competition. Training programs should be tailored differently for each respective competition, considering specificities of playing positions as well. Specifically, given that a greater degree of physical demand was found for defensive and midfield players from UCL, overall conditioning status for players on these positions (e.g., CDs, FBs, CMs, and WMs) should be at higher level when playing in UCL than in WC. In addition, considering CDs' increased high intensity running distance which directly corresponds to the intensity of the anaerobic threshold (Modric, Versic, & Sekulic, 2021), CDs playing in UCL should have better developed anaerobic capacities compared to their peers playing in WC.

The present investigation has some limitations that should be considered. Firstly, although all matches were analysed with optical tracking system and the same threshold for high intensity running was applied, it should be emphasized that data provider were different which could influence the established differences between competitions to some extent. Secondly, not all matches from UCL and WC were analysed, which reduced the number of observations and may have affected RP. Thirdly, situational factors such as team and opposition quality, match location or match outcome, which may influence RP in national competitions (Castellano, Blanco-Villaseñor, & Alvarez, 2011),

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Disclosure of interest

The authors report no conflict of interest.

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were not considered in the current study. However, very recent study demonstrated small influence of such situational factors on RP in highest-level soccer (Modric et al., 2022); therefore, influence on results in current study may be negligible. Further studies with longitudinal design and larger sample are necessary to confirm the present results while controlling for several situational factors. Finally, for a more detailed understanding of physical performance during the UCL and WC, there should be some attempt to account for accelerations rates.

Despite the limitations, there are several important contributions which current study provides. Firstly, this study was the first to examine position-specific comparative analysis of RP of professional soccer match-play across two highest-level soccer competitions: UCL and WC. This enables soccer practitioners a more thorough understanding of the physical requirements for playing in UCL and WC. Secondly, the findings from current study may serve soccer coaches in decision making process of structuring specific training programs. Thirdly, the position-specific approach is important strength of current investigation as it allows "real-world" applications of the findings. In the end, although not being the final word on a problem, results will improve the knowledge in area and may initiate further research.

In conclusion, this study demonstrated differences in various aspects of physical performance between two highest-level soccer competitions with variations dependent upon playing position. Specifically, greater physical performance of defensive and midfield players playing in UCL was evidenced compared to their peers playing in WC. Based on such findings, it is recommended that overall conditioning status for defensive and midfield players should be at higher level when playing in UCL than in WC. Additionally, CDs playing in UCL should have better developed anaerobic capacities compared to their peers playing in WC due to their increased high intensity running distance evidenced in UCL.

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