



# Monitoring Technical Performance in the UEFA Champions League: Differences Between Successful and Unsuccessful Teams

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## Abstract

This study attempted to identify associations between the TP (technical performance) of top-elite football (soccer) players according to achievement of their teams and match outcome in UEFA Champions League (UCL). TP were evaluated by position specific InStat index which was calculated on the basis of a unique set of key parameters for each playing position. The participants (n = 179) were professional football players from teams that competed in the group stage of UCL in the 2020/21 season. Players were classified according to playing positions, and all data were obtained from 20 matches. Team achievement was defined by three criteria: (i) qualifying of the team from the group stage into the knockout stage of UCL, (ii) the final ranking of the team in the group, and (iii) total group points earned at the end of the group phase of UCL. The results indicated a higher InStat index when teams (i) won matches, (ii) qualified into the knockout stage, (iii) achieved a higher position on the table, and (iv) earned more group points. These findings confirmed that the InStat index is a valid discriminator of TP between successful and unsuccessful teams.

**Keywords:** soccer, success, technical abilities, match outcome



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MONITORING TECHNICAL PERFORMANCE IN ELITE FOOTBALL

<http://mjssm.me/?sekcija=article&artid=236>

**Cite this article:** Modric, T. Versic S., & Jelacic M. (2022). Monitoring Technical Performance in the UEFA Champions League: Differences Between Successful and Unsuccessful Teams. *Montenegrin Journal of Sports Science and Medicine*, 11 (2), 3–11. <https://doi.org/10.26773/mjssm.220901>

## Introduction

Performance indicators are defined as a “selection and combination of variables that define some aspect of performance and that help achieve athletic success” (Lago-Peñas & Lago-Ballesteros, 2011). In general, performance indicators in football (soccer) can be observed as: (i) indicators of technical abilities; (ii) indicators of physical abilities; and (iii) indicators of tactical abilities. To evaluate technical abilities, the most frequently used performance indicators are passes, shots, crosses or dribbles (Yi, Jia, Liu, & Gómez, 2018; Konefal et al., 2019a).

The most frequently used performance indicators for evaluating physical abilities are different kinematic data (i.e., total distance covered, distance covered in different speed zones, accelerations/decelerations) (Modric, Versic, & Sekulic, 2021; De Albuquerque Freire et al., 2022). Finally, to evaluate tactical abilities, inter-player coordination, inter-team coordination before critical events and team-team interaction and compactness coefficients are mostly used (Memmert, Lemmink, & Sampaio, 2017). Interpretation of such data seeks to generate knowledge about team properties and the patterns that

Received: 22 April 2022 | Accepted after revision: 29 May 2022 | Early access publication date: 12 June 2022 | Final publication date: 1 September 2022

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Conflict of interest: None declared.

characterize their organization, with implications for designing strategies to achieve success (Travassos, Davids, Araújo, & Esteves, 2013; Sarmento et al., 2018).

Success in football is dependent on the cooperative and competitive interactions between individuals (Ribeiro, Silva, Duarte, Davids, & Garganta, 2017; Aquino et al., 2018). Therefore, to identify the factors that lead to success in football, it is necessary to determine performance indicators that significantly distinguish winners from losers (Lepschy, Wäsche, & Woll, 2018). For instance, some studies have reported that running performance is not the best discriminator between successful and unsuccessful teams (Hoppe, Slomka, Baumgart, Weber, & Freiwald, 2015; Asian Clemente et al., 2019), while other studies have reported that technical variables were important discriminators between winners and losers (Lago-Peñas, Lago-Ballesteros, Dellal, & Gómez, 2010; Castellano, Casamichana, & Lago, 2012; Zhou, Zhang, Lorenzo Calvo, & Cui, 2018). In general, there is a global consensus that technical parameters should be observed as better predictors of success in football than pure physical parameters (Rampinini, Impellizzeri, Castagna, Coutts, & Wisløff, 2009; Lago-Peñas et al., 2010; Lago-Peñas, Lago-Ballesteros, & Rey, 2011; Castellano et al., 2012; Liu, Gómez, Gonçalves, & Sampaio, 2016).

However, most of the previous studies utilized technical variables separately, one by one. Such a unidimensional approach is incapable of describing a multidimensional view of football performance, seen as a combination of different technical features (Pappalardo & Cintia, 2018). To the best of our knowledge, only two multidimensional approaches are known to be valid for determining the technical performance of players: sports profiling techniques and position-specific performance statistics indices (InStat index) (Butterworth, O'Donoghue, & Cropley, 2013; Modric, Versic, Sekulic, & Liposek, 2019).

The basic principle of the sports profiling technique is to combine a set of valid and reliable performance-related variables within a given sport to properly describe a certain performance/performer using normative match data (Butterworth et al., 2013). Not surprisingly, authors have regularly applied this technique to assess technical performance among football players (Liu, Yi, Giménez, Gómez, & Lago-Peñas, 2015; Liu et al., 2016; Konefał et al., 2018). Despite its anticipated usefulness, the InStat index is a relatively new technique for assessing technical performance in football. In detail, the InStat index is calculated on the basis of a unique set of key parameters for each playing position (i.e., 12–14 performance parameters, depending on the playing position), with a higher numerical value indicating better performance (Modric, Versic, & Sekulic, 2020). While sports profiling techniques use the same variables to evaluate technical performance at different playing positions, the InStat index uses position-specific variables (i.e., different for each playing position) to determine technical performance at different playing positions. Considering that different playing positions require different tactical roles, which means different technical performances as well (Konefał et al., 2019b), it is questionable whether the InStat index can be used as a tool for assessing position-specific technical performances in football.

The validity of the InStat index has been demonstrated recently using data from the Croatian league (Modric et al., 2019). Specifically, authors confirmed the validity of the InStat index throughout the analysis of the association between In-

Stat index parameters and final game achievement in Croatian professional football, indicating higher technical performance when teams win (Modric et al., 2019). However, that study did not include important indicators of the team achievement, such as position on the table or earned points (Modric et al., 2019). Collectively, to the best of our knowledge, there is no information on how technical performance evaluated by the InStat index affects team success. Therefore, the main objective of this study was to identify the association between technical performance evaluated with the InStat index and (i) match outcome, (ii) team achievement in elite football, specifically the UEFA Champions League (UCL). The authors were of the opinion that the findings could enable a better understanding of the technical performances of the most successful football teams in the world. Initially, we hypothesized that better values of technical performance evaluated with the InStat index would be associated with the success of teams competing in the UCL.

## Methods

### *Participants and Design*

Participants (n=179) in this study were top-elite football players from teams that competed in the group stage of the UEFA Champions League in the 2020/21 season. All technical performances, evaluated by the InStat index, were obtained from the 20 matches from groups A (n=3), B (n=3), C (n=4), E (n=4), F (n=3) and G (n=3), resulting in 244 technical performances used as cases for this study. Only the results of those players who participated in whole matches were analyzed. Goalkeepers were excluded from the analysis due to the specificity of the position. Players' performance were divided according to football-specific playing positions as follows: central defenders (CD; n=79), full-backs (FB; n=65), central midfielders (CM; n=55), wide midfielders (WM; n=28), and forwards (FW; n=17).

Technical performances (i.e., values of the InStat index) were classified according to the: (i) match outcomes of analyzed matches (win: n=68, draw: n=96, lost: n=80); (ii) qualification of the team from the group stage into the knockout stage of the UCL (qualified: n = 99, not-qualified: n=145); and (iii) final position at the end of the group stage of the UCL (1<sup>st</sup>, n=51, 2<sup>nd</sup>, n=48, 3<sup>rd</sup>, n=73, 4<sup>th</sup>, n=72). The investigation was approved by the Ethical Board of Faculty of Kinesiology, University of Split.

### *Procedures*

Technical performances for each player were evaluated by the position-specific InStat index (InStat Limited, Limerick, Republic of Ireland). The InStat index is calculated on the basis of a unique set of key parameters for each playing position (12–14 performance parameters, depending on the position during the game), with a higher numerical value indicating better performance. The exact calculations are trademarked and known only to the manufacturer of the platform. In the most general terms, an automatic algorithm considers the player's contribution to the team's success, the significance of his or her actions, the opponent's level and the level of the competition in which the team plays (i.e., the same performance in the European Champions League and some national-level first division play is not rated with the same values). The rating is created automatically, and each parameter has a factor that changes depending on the number of actions and events in the match. The weight of the action factors differs depending on the player's position. For example, grave mistakes made by

CDs and their frequency affect the InStat index to a greater extent than those made by FWs. The key factors included in the calculation of the InStat index are position specific and include tackling, aerial duels, set pieces in defense, and interceptions (for CDs); number of crosses, number of passes to the penalty area, and pressing (for FBs); playmaking, number of key passes, and finishing (for CMs); pressing, dribbling, finishing, and counterattacking (for WMs); and shooting, finish-

ing, pressing, and dribbling (for FWs). To calculate the InStat index, the player must spend a certain amount of time on the field and perform a minimum number of actions, but in this study, this issue was resolved simply by including only those players who played the whole game. The example calculation of InStat index is presented in Figure 1. The use of the InStat index has appeared in previous studies (Modric et al., 2019; Modric et al., 2020).

Technical parameters	Quantity / percentage	Factor
Pass accuracy	83.60%	1.075104
Key and extra-attacking passes	1	1.075104
Accurate passes into the box	1	1.024528
Shots (number)	0	1.007670
Share of successful dribbles	23.10%	1.041387
Participation in the goal attack	25%	1.053333
Grave mistakes	0	1.007670
Inaccurate key and extra-attacking passes	1	1.016667
Share of challenges won	90.10%	1.142537
Shots wide	1	1.016667
Multiplying all factors		= 1.557639
The weighted match level coefficient that takes into account the player's level, and the levels of his team-mates and opponents		= 0.9988165276
Base level of the InStat index		= 220
The final InStat indeks = 1.557639 x 0.9988165276 x 220 = 342		

\*\* Not all technical parameters were included

**Figure 1.** Example of calculated InStat index for the fullback players

Team achievement in this study was defined by three criteria: (i) qualifying of the team from the group stage into the knockout stage of the UCL (Qualification); (ii) the final ranking of the team at end of the group stage of the UCL (Placement); and (iii) total group points earned at the end of the group phase of UCL competition (Points). The UCL group contained 8 groups, and each group consisted of 4 teams. After 6 played matches in the group, the first- and second-ranked teams from each group advanced for competition in the knockout stage, actually meaning that qualifying for the knockout stage promotes teams into the “best 16 teams” in Europe. Therefore, the teams were classified as either “qualified” (placed 1<sup>st</sup> and 2<sup>nd</sup> in the group) or “nonqualified” (placed 3<sup>rd</sup> and 4<sup>th</sup> in the group phase), observed as the first criterion of team achievement. Also, the final team rankings and total group points after all played matches in the group stage of the UCL were used as second and third criteria of team achievement, respectively.

Additionally, the variables in this study included match outcome (win, draw, loss) and playing positions (CD, FB, CM, WM, FW).

### Statistics

The normality of the distributions was checked by the Kolmogorov-Smirnov test, and the statistics included means  $\pm$  standard deviations. The homoscedasticity of all of the variables was confirmed by Levene's test.

Differences among playing positions in the InStat index were analyzed by ANOVA. The validity of the InStat index was checked in four phases.

As a preliminary analysis of this study we correlated technical variables obtained from technical performance-related

match data and InStat index, in order to evaluate validity of InStat Index as an indicator of technical performance. For such purpose we calculated multiple regression analysis with technical variables as predictors, and InStat index as criterion. Multiple correlations (multiple R) and coefficient of determination ( $R^2$ ) were calculated and reported for total sample.

In the first phase, the technical performances evaluated by the InStat index were associated with the final match outcome by one-way analysis of variance (ANOVA), with the match outcomes (loss, draw, win) as independent variables. The differences were established for the total sample of players and separately for each playing position. This process allowed for the identification of the validity of the InStat index as an indicator of the final match achievement for the total sample and for the five observed playing positions.

Next, technical performances evaluated by the InStat index were associated with team success indicators. Specifically, using two-factor ANOVA, the InStat index was associated with “Qualification” and “Placement” (as previously described in the Procedures section). For this procedure, “Qualification” (yes/no) and “Placement” (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>) were considered the main factors and were additionally checked for interaction (Position x Qualification). Apart from the F-test and significance, the effect size was determined through the calculation of partial eta squared ( $\eta^2$ ) (>0.02 is small; > 0.13 is medium; > 0.26 is large) (Ferguson, 2016).

In the last phase, Pearson's correlation was used to identify associations between the InStat index and total group points. Correlations were calculated for the total sample and stratified for playing positions.

The level of statistical significance was set at  $p < 0.05$ . For

all of the analyses, Statistica software, version 13.0 (TIBCO Software Inc., Greenwood Village, CO, USA), was used.

## Results

Technical variables as predictors obtained from technical performance-related match data were significantly correlated with InStat index as criterion, evidencing the appropriate va-

lidity of InStat index as an indicator of technical performance during the game. In brief, predictors explained 60% of criterion's variance (Table 1). Significant partial influence (significant beta ponders) was evidenced for: defensive challenges won (0.77), total defensive challenges (-0.69), attacking challenges won (0.40), percent of accurate passes (0.48), percent of tackles won (0.19), total shots (0.16) and assists (0.12).

**Table 1.** Multiple regression calculation with technical variables as predictors and InStat index as criterion

	$\beta$	Std.Err. $\beta$	b	Std.Err. b	t(206)	p
Intercept			24.27	56.83	0.43	0.67
Goals	0.15	0.12	24.01	18.77	1.28	0.20
Assists	0.12	0.05	18.31	8.02	2.28	0.02
Chances	0.03	0.09	1.25	4.15	0.30	0.76
Chances created	0.01	0.12	0.77	6.17	0.12	0.90
Chances successful	0.11	0.12	15.26	16.64	0.92	0.36
Shots	0.16	0.08	6.49	3.02	2.15	0.03
Shots on target	0.17	0.12	11.90	8.82	1.35	0.18
Shots on target (%)	-0.16	0.09	-20.89	12.20	-1.71	0.09
Passes	1.55	0.81	2.85	1.49	1.91	0.06
Passes accurate	-1.62	0.85	-3.06	1.61	-1.90	0.06
Passes accurate (%)	0.48	0.13	253.24	66.66	3.80	0.00
Key passes	0.14	0.10	6.27	4.22	1.48	0.14
Key passes accurate	0.05	0.12	3.29	8.29	0.40	0.69
Crosses	0.00	0.09	-0.10	1.92	-0.05	0.96
Crosses accurate	0.13	0.11	7.20	6.19	1.16	0.25
Accurate crosses (%)	-0.05	0.08	-9.71	13.72	-0.71	0.48
Lost balls	0.06	0.11	0.69	1.31	0.53	0.60
Lost balls in own half	-0.02	0.06	-0.59	1.90	-0.31	0.76
Ball recoveries	0.05	0.10	0.62	1.24	0.50	0.62
Ball recoveries in opponent's half	-0.01	0.06	-0.32	1.85	-0.17	0.86
Defensive challenges	-0.69	0.21	-7.40	2.28	-3.25	0.00
Defensive challenges won	0.77	0.25	10.65	3.44	3.09	0.00
Defensive challenges won (%)	-0.03	0.11	-5.50	19.71	-0.28	0.78
Attacking challenges	-0.32	0.20	-2.70	1.71	-1.58	0.12
Attacking challenges won	0.40	0.18	6.53	2.94	2.23	0.03
Attacking challenges won (%)	-0.07	0.07	-9.65	9.73	-0.99	0.32
Air challenges	0.18	0.15	2.63	2.26	1.16	0.25
Air challenges won	-0.19	0.18	-3.87	3.63	-1.07	0.29
Air challenges won (%)	0.06	0.07	7.20	9.13	0.79	0.43
Dribbles	-0.05	0.16	-1.03	3.19	-0.32	0.75
Dribbles successful	0.07	0.18	1.96	4.98	0.39	0.69
Dribbles successful (%)	0.04	0.08	4.33	7.87	0.55	0.58
Tackles	0.09	0.13	1.82	2.81	0.65	0.52
Tackles successful	-0.04	0.16	-1.23	4.64	-0.26	0.79
Tackles won (%)	0.19	0.09	21.87	10.04	2.18	0.03
Ball interceptions	0.03	0.07	0.41	0.94	0.44	0.66
Free ball pick ups	0.07	0.06	1.10	0.83	1.32	0.19
R	0.77					
R <sup>2</sup>	0.60					
p	0.001					

Intercept – interception coefficient,  $\beta$  – standardized regression coefficient, B – non-standardized regression coefficient, R – coefficient of the multiple correlation, R<sup>2</sup> – coefficient of determination

There were no differences in the InStat index among players at different playing positions (F-test: 0.57;  $p=0.68$ ;  $\eta^2=0.009$ ). Specifically, the average values of InStat index were: CD=290±46, FB=292±43, CM=282±40, WM=293±46, and FW=281±43.

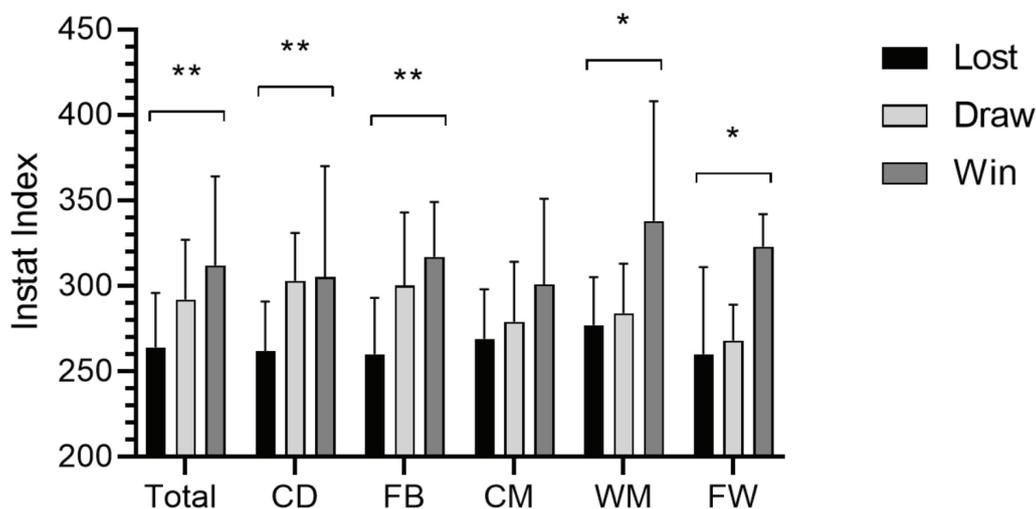
Table 2 presents results of multifactorial ANOVA calculations for: (i) match outcome x playing position, (ii) placement x playing position, and (iii) qualification x playing position. In all three calculations, achievement of the teams (match outcome, placement, and qualification) were found as significant main effects, evidencing the significant influence of InStat on achievement of the teams.

**Table 2.** Multifactorial ANOVA of InStat index with (i) Match outcome and Playing position, (ii) Placement and Playing position, (iii) Qualification and Playing position as main factors

	Main factors		Interaction
	Match outcome	Playing position	Match outcome x Playing position
F test	22.33	0.96	1.47
p	0.001	0.43	0.17
$\eta^2$	0.16	0.02	0.05
	Placement	Playing position	Placement x Playing position
F test	17.09	1.66	1.01
p	0.001	0.16	0.44
$\eta^2$	0.16	0.03	0.05
	Qualification	Playing position	Qualification x Playing position
F test	44.25	1.32	0.91
p	0.001	0.26	0.46
$\eta^2$	0.16	0.02	0.02

Differences in the InStat index for total sample and stratified for playing positions, with regard to match outcome (win, draw, loss) are presented in Figure 2. When total sample was observed (i.e. not dividing players according to playing position) players achieved significantly higher (F-test=26.52,

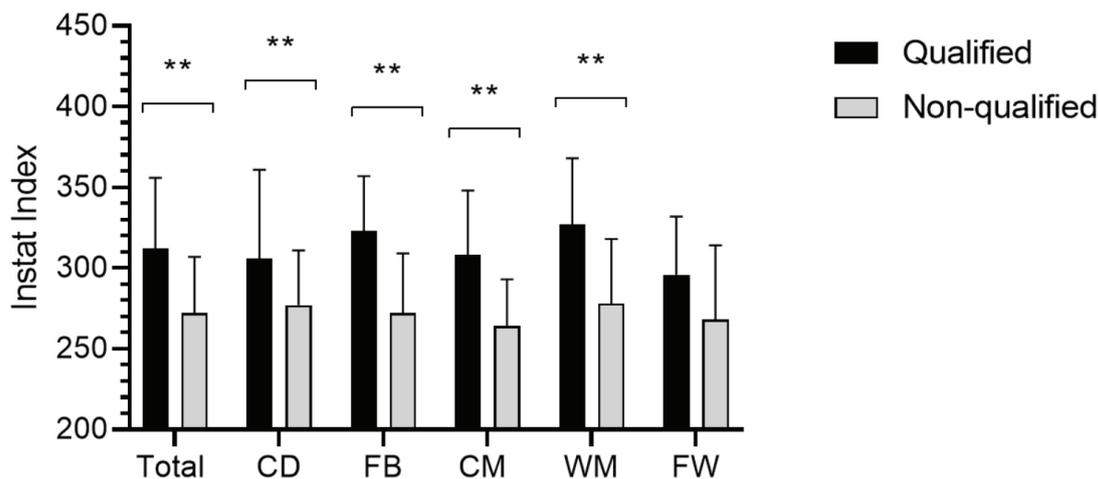
$p<0.01$ ) values of the InStat index when their teams won the matches and the lowest values when their teams lost the matches (312 and 264, respectively). Similar associations were found for CD (F-test=8.61,  $p<0.01$ ), FB (F-test=12.68,  $p<0.01$ ), WM (F-test=4.67,  $p<0.02$ ), and FW (F-test=5.36,  $p<0.02$ ).



**Figure 2.** Differences in the InStat index according to the match outcome (win, draw and loss) for total sample and for specific playing positions. \*\*  $p<0.01$ ; \*  $p<0.05$

Values of InStat index were higher for the players who played in teams that have been qualified from group stage of Champions league (CD=306, FB=323, CM=308, WM=327, FW=296) when compared to those who did not (CD=277, FB=272, CM=264, WM=278, FW=268). Significant association between InStat index and achievement of the teams observed as a qualification for knock-out phase are evidenced for total sample (F-test=59.6), CD (F-test=8.33), FB (F-test=32.06), CM (F-test=21.58), WM (F-test=9.13) (all  $p<0.01$ ) (Figure 3).

In general, the highest InStat index was found among players who played on teams that finished as first ranked in the UCL group stage, followed by players who played on 2nd- and 3rd-ranked teams (315, 308 and 279, respectively). The lowest InStat index was found for players who played in bottom-ranked teams (266). Observing playing positions, the results indicated that FB, CM and FW with the highest values of the InStat index were first ranked, while CD and WM with the highest InStat indices were second ranked at the end of the UCL group stage (Table 3)



**Figure 3.** Differences in the players’ InStat index according to the qualification of their teams from the group stage of UCL. \*\* - indicates significant post-hoc differences at  $p < 0.01$

InStat index was significantly correlated (all  $p < 0.01$ ) with total points in the group for total sample ( $r = 0.46$ ) and specifically for CD ( $r = 0.33$ ), FB ( $r = 0.59$ ), CM ( $r = 0.54$ ) and FW

( $r = 0.49$ ). Correlation between InStat index and total points in the group was 0.41, but did not reach level of statistical significance ( $p = 0.10$ )

**Table 3.** Descriptive statistics and differences of InStat Index in relations to final position in the group stage UCL (data are given as Means ± Standard deviations)

	Placement				ANOVA		
	1st	2nd	3rd	4th	F-test	p	$\eta^2$
Total sample (n=244)	315±48 <sup>3,4</sup>	308±40 <sup>3,4</sup>	279±37 <sup>1,2</sup>	266±33 <sup>1,2</sup>	21.64	0.01	0.21
Central defenders (n=79)	301±77	310±29 <sup>4</sup>	290±38	267±28 <sup>2</sup>	3.92	0.01	0.13
Fullbacks (n=65)	334±31 <sup>3,4</sup>	311±34 <sup>4</sup>	274±30 <sup>1</sup>	270±43 <sup>1,2</sup>	11.73	0.01	0.36
Central midfielders (n=55)	312±33 <sup>3,4</sup>	303±46 <sup>4</sup>	268±28 <sup>1</sup>	259±32 <sup>1,2</sup>	7.38	0.01	0.3
Wide midfielders (n=28)	316±12	366±94	281±46	273±32	4.03	0.02	0.33
Forwards (n=17)	313±22	280±43	286±66	254±19	1.56	0.25	0.26

Superscripted numbers indicate significant post-hoc differences in InStat index (<sup>1</sup>significantly different from first position, <sup>2</sup>significantly different from second position, <sup>3</sup>significantly different from third position, <sup>4</sup>significantly different from fourth position)

**Discussion**

The main objective of this study was to identify associations between the technical performances of football players, and achievement of their teams, in the most elite football competition in the world – the UCL. The results revealed that technical performances evaluated by the InStat index were associated with: (i) match outcome; (ii) qualification from the group stage of the UCL; (iii) final ranking in the group stage of the UCL; and (iv) total group points. Specifically, criterion-related validity indicated higher players’ InStat index when: (i) teams won the match; (ii) teams were qualified into the knockout phase; (iii) teams achieved better placement on the table; and (iv) teams earned more group points. Therefore, our initial hypothesis can be accepted.

*Playing positions and InStat index*

Football players at different playing positions require different technical abilities (Konefał et al., 2019b). The InStat index is a relatively new tool that provides a unique measure for evaluating position-specific technical performance (i.e., abilities) in football. Previous works demonstrated that InStat index in general cannot be compared across playing positions (Modric et al., 2019; Modric et al., 2020). In detail, Modric et al., in their two recent studies, did not indicate differences in

the InStat index for different playing positions in the Croatian National Championship. In support, our results did not show significant differences in the InStat index among UCL players playing at different positions (F test=0.57,  $p > 0.05$ ). Therefore, the lack of differences among playing positions in InStat index indicates that this index might be observed as an applicable measure of position-specific technical performance in top-elite football.

Next, it must be emphasized that InStat index is not comparable across the different competitions due to the specificity of the algorithm, which includes the level of competition as one of the factors in the calculation (please see Methods section for details). For example, the equal technical performance in the UCL, and in some national-level competition will not be rated with the same values simply because higher performance-level of UCL logically implies better opponent. In other words, since the UCL is the most prestigious club football competition in the world (Lago-Peñas et al., 2011), the technical performances of the players from the UCL will be additionally pondered, which will consequently result in higher values of InStat index for UCL performances. Therefore, technical performances evaluated by InStat index are exclusively comparable within the same competition.

### *Match outcome and InStat index*

A previous study performed in the Croatian National Championship demonstrated that the InStat index was related to the final match outcome and consequently should be considered a valid measure of final team achievement at that competitive-level (Modric et al., 2019). In brief, the authors indicated higher values of the InStat index when winning for all playing positions, and these findings actually confirmed the criterion validity of the InStat index in the evaluation of final match achievement (observed as criterion variable) in Croatian professional football. However, to confirm applicability in the UCL the validity of the InStat index should be verified utilizing data observed from the matches played in the UCL.

To the best of our knowledge, this study is the first in which the InStat index was validated in the UCL, and the results indicated the highest values of the InStat Index when teams won matches, followed by lower values when teams played to draws, and the lowest InStat values when teams lost matches. This trend is particularly evident for FB, WM, FW and CD (large to moderate effect sizes). Although the association between the InStat index and team achievement did not reach the required statistical significance for CM ( $p=0.06$ ), the equal trend of results (i.e., better InStat index for won matches) was also evident for this position. Altogether, results supported previous considerations that technical performance are important determinant for achieving positive match outcome in elite football competitions (Konefał et al., 2018). Specifically, the fact that higher technical performance contributed to winning matches in the UCL was the first phase in confirmation of the criterion-validity of the InStat index in the evaluation of achievement in the UCL.

### *Achievement in the group stage of UCL*

To additionally evaluate the criterion-related validity of the InStat index, we observed players' InStat index in relation to their team achievement in the group stage of UCL. Our results consistently indicated higher values of the InStat index for the players of the teams that were qualified from the group-stage UCL than for their peers who played for teams that did not qualify. Basically, these findings indicate that (i) technical performance is a highly important discriminator between successful and unsuccessful teams (Lago-Peñas et al., 2010; Castellano et al., 2012; Zhou et al., 2018), (ii) InStat index should be considered as valid measure of technical performance in football of most advantageous level.

In the third phase, we validated InStat index with regard to final position of the team in UCL group. Specifically, results indicated strong association between InStat index and the final position of the team. Specifically, the InStat index was highest among players that played on teams that finished as first ranked in the UCL group stage, followed by players who played on 2<sup>nd</sup>- and 3<sup>rd</sup>-ranked teams (315, 308 and 279, respectively). The lowest InStat index was found in players who played on bottom-ranked teams (i.e., 4<sup>th</sup> position in the group) (Table 4). These findings once again demonstrated that higher technical performance contributes to greater achievement in football (Rampinini et al., 2009; Konefał et al., 2018).

However, it should be noted here that extended analysis of the InStat index according to the different playing positions revealed that CDs and WMs from the first ranked teams did not achieve the highest InStat index. In detail, the highest InStat index was achieved by CDs and WMs from the teams that

finished in the second positions in the UCL group stage. Since this issue was not evident when observing a larger sample (i.e., total sample), the authors believe that these results were influenced by a limited number of observations when players were divided into smaller groups (i.e., according to the playing positions), limiting the possibility of reaching appropriate statistical significance of correlations (Huck, 2011). Also, it is possible that technical performances of some other playing positions, and not CDs and WMs are more important in achieving the success in UCL, but it should be studied in more details in future studies.

All of the previously discussed findings of proper criterion-related validity of the observed measurement tool can be additionally supported by analysing associations between the InStat index and total group points at the end of the group stage of the UCL (Table 5). In particular, our results showed moderate correlations between the InStat index and total group points for the total sample ( $r=0.46$ ), and specifically for each playing position ( $r=0.33-0.59$ ). It should certainly be emphasized that only for WMs was the numerical value of the correlation not statistically significant ( $p=0.10$ ). Since the correlation coefficient for this group is still reasonably high ( $r=0.41$ ), these findings indicate the existence of a relationship between players' technical performance (i.e., evaluated by the InStat index) and the achievement of their teams defined by total group points.

Collectively, the results from our study demonstrated that achieving greater technical performance enables: (i) more points to be earned, (ii) higher final ranking at the end of the group stage in the UCL, which altogether result in qualification to the knockout stage and promotion of teams to the 16 best in Europe. These findings actually support the previous idea that overall technical and tactical effectiveness likely has a large impact on results and a team's final league ranking in football (Carling, 2013; Asian Clemente et al., 2019), but also point to proper criterion related validity of the InStat index in the evaluation team-achievement in the UCL.

### *Limitations and Strengths*

This study did not analyse all of the matches from the group stage of the UCL. Specifically, only 20 randomly selected matches were observed. Additionally, because of methodological reasons, only players who played whole matches were included in analysis. This limitation reduced the number of observations when the total sample was divided according to playing positions, which could have affected the results obtained for the InStat index. Further, the team indicators of the number of goals conceded and scored were not analysed, nor was the goal difference achieved toward the criterion for differences between teams' success rates. On the other hand, this study included matches and players involved in the most prestigious football competition in the world and provided information on validity of the specific and widely used measurement tool for monitoring technical performances of football players. Additionally, since the evaluated tool was clearly related to match outcomes and to success of the teams, this study demonstrated that InStat index parameters can be important discriminators between successful and unsuccessful teams. Furthermore, the position-specific approach from this study enabled insight into the individual technical performances of top-elite football players, specifically for each playing position.

## Conclusion

The findings from this study confirmed that the InStat index is a valid discriminator of differences between successful and unsuccessful teams. Specifically, criterion-related validity indicated higher technical performance of the players (i.e., higher InStat index) when their teams: (i) won matches; (ii) qualified into the knockout; (iii) achieved a higher position on the table; and (iv) earned more points in the group phase of the UCL. Furthermore, the results from our study supported previous studies reporting that technical performance is an important discriminator between successful and unsuccessful teams.

Since position-specific analysis of the InStat index did not indicate differences among playing positions, this index might be observed to be an applicable measure of position-specific technical performance in top-level football. Simply stated, higher numerical values of the InStat index indicate better technical performance. This fact will enable football practitioners to monitor the technical performances of top-elite football players without addressing a large amount of data.

This study provided data about the validity and applicability of the observed measurement tool in the UCL, which is known to be the most prestigious football competition in the world. However, since the InStat index is derived on the basis of specific parameters and specifically scored for different competitive levels, further analyses are needed to validate this measurement tool in other competitions and competitive levels.

## Acknowledgements

Support of the Croatian Science Foundation is gratefully acknowledged (grant number DOK-2020-01-9298). Authors are particularly grateful to InStat Limited, Limerick, Republic of Ireland for providing the data used in the study.

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