

ORIGINAL SCIENTIFIC PAPER

Analysis of the Associations between Contextual Variables and Match Running Performance in Croatian First Division Soccer

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Abstract

It has been hypothesized that contextual variables (i.e. match location, opponents' level) could be important determinants of running performance (RP) in soccer matches, but empirical studies provided inconsistent evidences. This study aimed to investigate the associations between contextual variables (CV) and RP in Croatian soccer players. Players' RP (n=193) were evaluated, and used as cases in this study. CV included match outcome (win-draw-loss), opponent's level (higher vs. lower ranked), and match location (home-away). RP were measured by global positioning system during the soccer matches in seasons 2018/19 (n=14) and 2019/20 (n=15) of Croatian first division, and included: the total distance covered, low-intensity (<14.3 km/h), running (14.4–19.7 km/h), high-intensity running (>19.8 km/h), high-speed running (19.8–25.1 km/h) and sprinting (>25.2 km/h). Results indicated significantly greater amount of distance covered in running zone for away matches (F-test: 7.83, $p < 0.01$, small effect size; 1392 ± 353 m and 1262 ± 294 m, for home and away matches, respectively). Similar RP were observed irrespective of opponents' level (F-test: 0.05 to 1.53, $p > 0.05$). Lowest total-, low- and running-zone distances were evidenced in won matches (9893 ± 896 m, 8035 ± 614 m and 1241 ± 312 m, respectively), followed by drawn matches (10298 ± 913 m, 8287 ± 838 m and 1363 ± 320 m, respectively) and lost matches (10355 ± 1052 m, 8279 ± 742 m and 1406 ± 343 m, respectively). This study demonstrated that (i) won matches were characterized by lower RP, (ii) association between RP and match location was limited, (iii) RP was not related to the opponents' level.

Keywords: situational factors, football, physical performance, match outcome, match location

Introduction

Running performance (RP) in soccer has been extensively researched in last decade what ultimately led to their better understanding (Paul, Bradley, & Nassis, 2015; Barrera, Sarmiento, Clemente, Field, & Figueiredo, 2021). Today is well known that soccer player can cover between 9 and 14 km during the matches, performing 5–15% of that distance in high intensity running (Andrzejewski, Chmura, Pluta, & Konarski, 2015; Modric, Versic, Sekulic, & Liposek, 2019). This wide ranges are determined by different variables that are associated with RP. For example, playing position in the game (Konefał et al., 2019; Modric, Versic, & Sekulic, 2020a; Chmura et al., 2021), players'

physical abilities and technical level (Sæterbakken et al., 2019; Modric, Versic, & Sekulic, 2021a), team's tactical formation (Modric, Versic, & Sekulic, 2020b), competitive level or league ranking (Bradley et al., 2013; Aquino et al., 2017) have all been associated with RP. These relationships can also be influenced by contextual variables (CV) such as match location, opponents' level and match outcome (Lago-Peñas, 2012; Paul et al., 2015; Trewin, Meylan, Varley, Cronin, & Ling, 2018; Barrera et al., 2021; Modric, Versic, & Sekulic, 2021b).

Authors regularly quantified RP according to the match outcome (e.g., winning, drawing, losing). However, empirical studies provided inconsistent evidences. Specifically, Barrera



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et al. (2021) investigated association between match outcome and RP of Portuguese players, and indicated greatest total distance covered in teams that were drawing (10395±875 m), followed by winning (9978±1963 m) and losing (9415±2050 m). Andrzejewski et al. (2016) analysed RP in context of match outcome and reported similar values of total distance covered irrespective of the match outcome for central defenders, fullbacks, central midfielders and wide midfielders, while only forwards achieved higher total distance covered in won matches. In terms of high intensity distance covered (>19.8 km/h), some older studies demonstrated that soccer players perform significantly less high intensity activities when winning than when losing (Bloomfield, Polman, & O'Donoghue, 2005; Castellano, Blanco-Villaseñor, & Alvarez, 2011; Lago-Peñas, 2012). Contrary, recent studies reported no differences in distance covered at higher speeds regardless of the match outcome (García-Unanue et al., 2018; Barrera et al., 2021).

Although home advantage in soccer is a well-known and well-documented fact (Lago-Peñas, 2012), literature overview indicates contrast findings regarding the associations between RP and match location. For example, authors quantified RP of Spanish and Brazilian players according to the match location, and reported that away matches accumulated significantly more of total distance than those played at home (García-Unanue et al., 2018; Aquino et al., 2020). Contrary, Barrera et al. (2021) evidenced greater total distance covered in home than in away matches (10208 and 9470 m, respectively). On the other hand, authors mostly reported similar values of high intensity distance covered irrespective of match location (Lago, Casais, Dominguez, & Sampaio, 2010; Aquino et al., 2020; García-Unanue et al., 2018).

It is often hypothesized that total distance covered and the amount of high-intensity running during soccer matches were higher when teams competed against higher ranked than against lower ranked opponents (Rampinini, Coutts, Castagna, Sassi, & Impellizzeri, 2007; Lago-Peñas, 2012). In contrast, Aquino et al. (2020) investigated RP in Brazilian professional soccer players, and revealed that teams covered greatest total distance when competed against lower ranked. Furthermore, García-Unanue et al. (2018) analysed RP of Spanish players according to the opponent's level, and did not indicate significant differences in RP between matches played against low-, medium- and high-level opponents.

Evidently, there is no clear relationship between RP and CV (e.g., match outcome, opponents' level and match location). Since previous cited studies included players from German 1st division, Portuguese and Spanish 2nd division and Brazilian 3rd division, such findings are not surprising. Most likely, these differences in RP are influenced with "cultural" factors of each league and competitions (García-Unanue et al., 2018). For example, English League is characterized by a direct style of play; Italian league is to be characterized by the defensive tactical rigor; and Spanish league favours the aesthetic side of the game and having greater control over the game (García-Unanue et al., 2018). Therefore, associations between RP and CV cannot be generalized and should be evaluated for each competition/league separately. Given to fact that there is no study which examined relationship between RP and CV in Croatian first division, the main objective of this study was to investigate the associations between RP and match outcome, opponents' level and match location. The findings from this study will provide new insights for understanding RP in Croatian soccer players.

Methods

Participants and design

RPs (n=193) of the players from the one team were analysed and used as cases in this study. All data were obtained with a global positioning system technique (see later for details) during the 14 matches in the season 2018/19 and 15 matches in the season 2019/2020 of the Croatian highest national soccer competition. RP was evaluated according to the match location (home: n=107, away: n=86), match outcome (win: n=82, draw: n=71, loss: n=40) and opponents' level (higher ranked: n=92, lower ranked: n=101, for details on division of teams on "higher ranked" and "lower ranked" please see details on Measurements). For the purpose of this study only RP of those players who participated in the whole match were analysed. In the observed period, team played 16 home and 13 guest matches, against 14 higher ranked teams and 15 lower ranked teams, and achieved 12 wins, 11 draws, and 6 losses. Matches that included red card or specific outputs (e.g., bad weather, bad pitch, matches against teams that mathematically assured title or relegation) were not analysed. At the end of the season 2018/19, team finished at 4th position at the table, while in season 2019/20 team finished at 5th position. The investigation was approved by Ethical Board of the Faculty of Kinesiology, University of Split.

Measurements

The variables in this study were divided in two sets: RP variables, and CV (match outcome, opponents' level and match location).

RP of the players was collected by GPS technology (Catapult S5 and X4 devices, Melbourne, Australia) with a sampling frequency of 10 Hz. Reliability and validity of the such devices were demonstrated previously (Johnston, Watsford, Kelly, Pine, & Spurrs, 2014). The RP included: the total distance covered (m), low-intensity (<14.3 km/h), running (14.4–19.7 km/h), high-intensity running (>19.8 km/h), high-speed running (19.8–25.1 km/h) and sprinting (>25.2 km/h). All RP variables were observed according to the CV.

CV included: (i) match outcome, (ii) opponents' level, and (iii) match location. Match outcome was assessed by win, draw or loss. Opponents' level included division of the teams into the higher ranked teams vs. lower ranked teams. Opponents were considered as "higher ranked" when observed team played against teams that were positioned from the 1st to 5th place on the table at the moment of the match. On the other hand, opponents were considered as "lower ranked" when observed team played against teams that were positioned from the 6th to 10th place on the table at the moment of the match (note that Croatian first division consists of 10 teams in total). Match location was coded as "home" when team played at home and "away" when team played away from home.

Statistics

The normality of the distributions was confirmed by the Kolmogorov–Smirnov test, and the data are presented as the means ± standard deviations. Homogeneity was checked by Levene's test.

Differences in RPs according to the match location and opponents' level were analysed by one-way analysis of variance. Effect sizes (ES) for differences in RP were evaluated by partial eta-squared values (>0.02 is small; >0.13 is medium; >0.26 is large) (Ferguson, 2016).

Multinomial logistic regression was used to identify the

association between RP (predictors) and match outcome. For such purpose match outcome was considered as criterion variable (won matches were coded as “3”, drawn matches as “2”, and lost matches as “1”). The Odds Ratio (OR), and 95% Confidence Interval (95%CI) were reported for each predictor variable.

For all analyses, Statistica 13.0 (TIBCO Software Inc., Greenwood Village, CO, USA) and SPSS 16.0 (IBM, Armonk, New York, USA) were used, and $p < 0.05$ was applied.

Results

Descriptive parameters for RP according to the different match outcomes are presented in Table 1. Total distance covered was lowest in won matches (9893±896 m), followed by drawn matches (10298±913 m) and lost matches (10355±1052 m). Also, lowest distances in low-, running- and high- intensity zones were found in won matches (8035±614 m, 1241±312 m and 617±224 m, respectively), followed by drawn matches

Table 1. Descriptive statistics for running performance according to the match outcome (data are given as Mean±SD)

	Match outcome		
	Win (n = 40)	Draw (n = 71)	Loss (n = 82)
Total distance covered	9893±896	10298±913	10355±1052
Low intensity running	8035±614	8287±638	8279±742
Running	1241±312	1363±320	1406±343
High speed running	460±152	490±175	499±144
Sprinting	157±99	156±103	162±79
High intensity running	617±224	646±251	661±194

(8287±638 m, 1363±320 m and 646±251 m, respectively) and lost matches (8279±742 m, 1406±343 m and 661±194 m, respectively). Sprinting distance was slightly greatest in lost matches

(162±79 m) in compared to won and drawn matches (156±103 m and 157±99 m, respectively).

Table 2 presents the results of multinomial logistic re-

Table 2. Differences in running performance according to the match outcome analysed by multinomial logistic regression (reference category is winning outcome)

Running performance	Match outcome	p	OR	95%CI	
Total distance	Lost	0.013	1.0005	1.0001	1.0009
	Draw	0.009	1.0004	1.0001	1.0008
Low intensity running	Lost	0.051	1.0005	0.9999	1.0011
	Draw	0.019	1.0006	1.0001	1.0011
Running	Lost	0.009	1.0016	1.0004	1.0028
	Draw	0.020	1.0012	1.0001	1.0022
High speed running	Lost	0.203	1.0015	0.9991	1.0039
	Draw	0.243	1.0012	0.9991	1.0032
Sprinting	Lost	0.792	1.0005	0.9966	1.0044
	Draw	0.927	0.9998	0.9965	1.0031
High intensity running	Lost	0.318	1.0008	0.9991	1.0025
	Draw	0.438	1.0005	0.9991	1.0019

OR – Odds Ratio; 95%CI – 95% Confidence Interval

gression for the match outcome. Total distance covered was positively related to the losses (OR: 1.0005; 95%CI:1.0001–1.0009) and draws (OR: 1.0004; 95%CI:1.0001–1.0008). Low intensity running was positively associated only with draws

(OR: 1.0006; 95%CI: 1.0001–1.0011), while running zone distance was positively associated with both losses (OR: 1.0016; 95%CI: 1.0004–1.0028) and draws (OR: 1.0012; 95%CI: 1.0001–1.0022). High speed running, sprinting and high

Table 3. Descriptive statistics and differences for running performance according to the match location determined by ANOVA (data are given as Mean±SD)

	Match location		ANOVA		
	Home (n = 107)	Away (n = 86)	F-test	p	Effect size η^2
Total distance covered	10032±921	10269±986	2.98	0.09	0.02
Low intensity running	8142±689	8222±621	0.69	0.41	0.00
Running	1262±294	1392±353	7.83	0.01	0.04
High speed running	468±149	493±170	1.14	0.29	0.00
Sprinting	159±97	157±97	0.02	0.88	0.00
High intensity running	627±222	649±236	0.46	0.50	0.00

intensity running were not associated with match outcomes ($p=0.203$ to 0.927).

Running zone distance covered was significantly greater for away matches (F-test: 7.83, $p<0.01$, small effect size; 1392 ± 353 m and 1262 ± 294 m, for home and away matches, respectively). Values of total distance covered, low intensity running, high speed running, sprinting and high intensity

running were similar irrespective of match location (F-tests: 0.02 to 2.98; $p>0.05$) (Table 3)

Results indicated similar values of all RP variables (total distance covered, low intensity running, running, high speed running, sprinting and high intensity running) whether the team played against higher or lower ranked opponent (F-tests: 0.52 to 1.53; $p>0.05$) (Table 4).

Table 4. Descriptive statistics and differences for running performance according to the opponents' level determined by ANOVA (data are given as Mean±SD)

	Opponents' level		ANOVA		
	Higher ranked (n = 92)	Lower ranked (n = 101)	F-test	p	Effect size η^2
Total distance covered	10160±1025	10118±892	0.09	0.76	0.00
Low intensity running	8160±699	8194±624	0.13	0.72	0.00
Running	1351±351	1292±303	1.53	0.22	0.00
High speed running	486±158	472±160	0.35	0.56	0.00
Sprinting	160±92	156±101	0.05	0.83	0.00
High intensity running	646±224	629±233	0.25	0.62	0.00

Discussion

This study investigated the associations between RP in CV (match outcome, match location and opponents' level) in Croatian professional soccer players. Results indicated three most important findings: (i) won matches were characterised by lower RP, (ii) association between RP and match location was limited, (iii) RP were not related to the opponent's level.

Match outcome

Our results evidenced significant associations between total distance covered, low intensity running and running zone distance covered with match outcome. Specifically, greater total- and running- zone distance covered were associated with losses and draws, while low intensity running was associated only with draws. In other words, won matches were characterized with lowest overall distance (9893 ± 896 m) and lowest distance covered at low (<14.3 km/h) and moderate ($14.4\text{--}19.7$ km/h) speeds (8035 ± 614 m and 1241 ± 312 m, respectively). In detail, total-, low- and moderate- distance covered in won matches were lower than in lost matches for approximately 5%, 3% and 13%, respectively. Although association between high intensity distance covered and match outcome were not significant, descriptive statistics indicated that high intensity distance covered in won matches was lower for approximately 7% and 5% then in lost and drawn matches, respectively. Putting it altogether, it is evident that won matches in Croatian first division were generally characterised by lower RP.

This altogether indicates that players do not always elicit their maximal physical capacities to win the matches as already noted (Lago et al., 2010). Consequently, it suggests that the results of the matches in Croatian first division are most likely determined by technical and tactical qualities of the players. Indeed, previous studies demonstrated that overall technical and tactical effectiveness probably has a greater impact on the results than RP (Carling, 2013; Asian Clemente et al., 2019). Since examined associations between RP and match outcome in this study were quite weak (please see Table 2), this can be directly supported with findings from our study which indicated that match outcome in general was not strongly influenced by RP.

Match location

Although home advantage in soccer has been extensively discussed (Lago et al., 2010; García-Unanue et al., 2018; Konefal et al., 2020; Barrera et al., 2021; Chmura et al., 2021), studies did not provide consistent evidence about association between RP and match location. For example, previous studies evidenced greater total-, low- and moderate distance covered in home matches, but did not observe differences at submaximal or maximal intensities (Lago et al., 2010; Aquino et al., 2020; Barrera et al., 2021). Similarly, our results also did not evidence differences for submaximal or maximal intensities (i.e., high speed running and sprinting) between home and away matches.

On the other hand, our study indicated some contrast findings when compared to the previously cited studies. Specifically, we evidenced significantly greater running zone distance covered in away matches. In detail, 10% higher running zone distance was evidenced in away matches in compared to the home matches (1392 ± 353 m and 1262 ± 294 m). Here it must be noted that small effect size ($ES=0.04$) was found for differences in running zone distance between home and away matches, what points to poor association with match location. Also, since all other RP's values were similar irrespective of match location (i.e. no significant differences were evidenced in RP when home- and away-matches were compared), findings from our study collectively demonstrate trivial overall association between RP and match location in Croatian first division. This basically supports previous consideration that influence of home advantage mainly occurs in technical activities rather than physical ones (Zhou, Hopkins, Mao, Calvo, & Liu, 2019; Chmura et al., 2021). Ultimately, it seems that association between RP and match location is strongly influenced by cultural factors of specific competition (Sarmiento et al., 2013; García-Unanue et al., 2018).

Opponents' level

Our results do not provide evidence on significant associations between RP and opponents' level. Specifically, no differences were found for any of the RP variables weather the team played against lower- or higher- ranked opponents. Although these findings are in the line with recent study that reported

very limited associations between RP and of opponents' level (García-Unanue et al., 2018), most of the previous studies actually indicated that total-, low-, and high- intensity distance covered were higher against "better" than against "weaker" opponents (Bloomfield et al., 2005; Rampinini et al., 2007; Lago et al., 2010). Oppositely, we have found similar values for all RP irrespective to the opponents' level, and from this perspective our results may seem little surprising.

However, the main differences between previously cited studies (Bloomfield et al., 2005; Rampinini et al., 2007; Lago et al., 2010) and our study is the fact that our study analysed only one team. In particular, here observed team played all matches in the same (or similar) tactical formation and preferred the same style of the play. Since RP is highly influenced by tactical formations (Modric et al., 2020b), it is reasonable to expect that the (same) tactical formation and style of play applied in all matches (i.e., against both higher and lower ranked) actually decreased possibility for identifying association between RP and opponents' level. Therefore, to confirm findings from this study RP of different teams should be quantified.

Strengths and limitations

The main limitation of this study comes from the fact that the sample was composed from soccer players that belonged to the same team. Also, due to the methodological reasons, we did not analyse all matches during the observed season, and

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Conflict of Interest

The author declares that there is no conflict of interest.

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included only those players who participated in whole matches. All this may influence reported results. On the other hand, this is the first study which analysed associations between RP and CV in Croatian soccer players. Additionally, the data were collected during official games, among professional players, and at the highest national competitive level. Despite the evident limitations, the authors believe that this study may contribute for understanding RP in Croatian soccer players and initiate further research.

Conclusion

This study emphasised that won matches were characterised by lower RP. It seems that Croatian first division soccer players regulate their physical efforts and do not always use their maximal physical capacities when winning. This may suggest that winning is more determined by technical-tactical qualities of the players than by RP. In addition, results from this study demonstrated limited association between RP and match location in Croatian first division, while RP and opponent's level were not inter-related at all. These findings enabled insight into the relationship between RP and contextual variables in Croatian first division players, what allows soccer coaches and analysts better understanding of RP in different circumstances. However, future studies should evaluate RP of other teams from Croatian first division to confirm presented findings.

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