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THE ANALYSIS OF HIGH-INTENSITY RUNNING PERFORMANCES IN BHT PREMIER LEAGUE OF BOSNIA AND HERZEGOVINA MATCHES

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Original research:

Abstract

The study aims to present in detail the analysis of high-intensity movement during official football matches of the highest rank in Bosnia and Herzegovina. The data (such as maximum speed, the number of accelerations, the number of sprints, (V4) the distance of high-intensity running ≥19,8 km/h, and (V5) the distance of sprint ≥25,2 km/h) have been collected using 20 Hz GPS (Global Positioning System) in 13 football matches (11 matches of the domestic league, BHT PL BIH, and two matches of BIH CUP in the first part of the 2019-2020 season). In total, there were n=74 individual match observations, of which central defenders (CD, n=18); fullbacks (FB, n=13); central midfielders (CM, n=23); wide midfielders (WM, n=15); and forwards (FW, n=5) were analyzed. The kinematic parameters were obtained by 20 Hz GPS Pro[2] (GPEXE, Exelio Srl, Udine, Italy). The statistical analysis results have shown that the average maximum speed equaled 29,7±1,6 km/h, the number of accelerations 19,9±7,4, the number of sprints 3,4±2,7, the distance (V4) 481±163, and the distance (V5) 127±85. Considering the positions of the players on the field, the full-backs obtained the highest maximum speed of (FB) 30,7±1,1 km/h, while the wide-midfielders, on average, performed, the most accelerations 27,6±6,4, sprints 6,2±3,3, and ran the longest distance in V4 (677±156) and V5 (213±104) zones. This study analyzed the differences between players' positions and quantified the physical demands of elite football players competing in the highest rank in Bosnia and Herzegovina. Based on the kinematic parameters data, the results show several statistical discrepancies related to the positions of the players in a match. The data offered in this study may be used in future analyses and comparisons. They represent the scientific ground for further construction and creation of specific training exercises concerning players' positions.

Keywords: GPS, match analysis, the distance of sprint, accelerations

Introduction

Football is one of the most complex sports in terms of locomotion. It is an intermittent game where short and very intensive activities alternate with low-intensity activities. Based on the analysis, it requires a high level of motor skills and abilities that are manifested in acyclic and variable movement structures. The analysis of kinematic parameters of players during the match has been very popular over the last twenty years. Currently, two match analysis systems are being used in football, GPS (Global Positioning System) and semi-automatic camera systems to track players on the field. GPS technology has become an integral part of high-end football today in training and match equipment. The device is based on microtechnology, which receives data from a minimum of 4 GPS satellites every twenty-hundredths of seconds (parameter for 20 Hz systems) and can be processed in real-time. Research results (Varley et al. 2011) have shown that data accuracy can vary from 1.9% to 6%. However, the authors (Castellano et al. 2011; Rampinini et al. 2015; Nagahara et al. 2017; Hoppe et al. 2018) find that GPS data generally satisfy reliability and validity and that the use of GPS systems can be used to analyze quantitative kinematic player parameters on the field.

Earlier analyzes of the football game showed that the top footballer exceeds 8 - 13 km (Di Salvo et al. 2009), performs 150-250 short high-intensity actions (accelerations, sprints, decelerations, changes of direction, jumps) (Vučetić and Jukić, 2017; according to Mohr et al. 2003). High-intensity activities take up about 12% of the total distance traveled at a game, while players take the remaining distance in walking and jogging (Rampinini et al 2007, Andrzejewski et al 2016). High-intensity running is, therefore, a crucial element and a valid measure of a player's physical

performance during a match (Di Salvo et al. 2009; Bradley et al. 2009), and emphasizes the importance and analysis of anaerobic activities in football. The results of previous studies (Bradley et al. 2009; Di Salvo et al. 2009; Di Salvo et al. 2010; Andrzejewski et al. 2016; Espin et al. 2017) showed that wide midfielders performed statistically significantly more in the high-intensity running zone and the sprint zone. They tend to perform more sprints and achieve the highest maximum speed in the game compared to other player positions.

This study aims to thoroughly analyze high-intensity runs during domestic league and cup games and to determine activity profiles concerning different player positions. The authors assume that wide midfielders will have greater distance traveled values in high-intensity running and sprint zones than other positions. The data obtained in this study can be used for future analyzes and comparisons, monitoring of training loads during the game itself, and is the basis for constructing and programming specific training exercises in relation to the position of players on the field.

Methods

The parameters of high-intensity motor activity were collected on the sample of football players (n = 22, age 27,1 ± 5,4) of the senior team of FC Borac Banja Luka, on 13 official matches (11 domestic league matches, BHT PL BIH and 2 CUP BIH matches) in the first part of the 2019/20 season. Total n = 74 individual match observations, of which central defenders (CD, n = 18); fullbacks (FB, n = 13); central midfielders (CM, n = 23); wide midfielders (WM, n = 15) and forwarders (FW, n = 5) were used for analysis (Table 1). Kinematic parameters, maximum speed (MS), number of accelerations (nAcc), number of sprints (nS), distance (V4), and sprint distance (V5) were obtained using a 20 Hz GPS Pro2 system (GPEXE, Exelio srl, Udine, Italy). Research, (Nagahara et al. 2017; Hoppe et al. 2018) confirmed the reliability and validity of the application of GPS systems in science and practice. The GPEXE unit defines acceleration as any change in travel speed of 2.5 m / s for 0.5 s, (V4) high-intensity running ≥19.8 km / h for a minimum of 0.5 s, (V5) sprint distance ≥25. 2 km / h for a minimum of 0.5 with a sprint speed of ≥25.2 km / h for a minimum of 1 s. All players were familiar with the experimental procedures and always wore the same GPS unit during the match to reduce measurement error. Also, the only data that were included in the analysis were from the players that played the entire game. All variables are represented by arithmetic mean and standard deviation (Table 1).

Table 1 Number of participants

The number of observations		%
Central defenders (CD)	18	24.3
Fullbacks (FB)	13	17.6
Wide midfielders (WM)	15	20.3
Forwarders (FW)	5	6.8
Central midfielders (CM)	23	31.1
Total	74	100

All variables are represented by arithmetic mean and standard deviation (Table 1). Differences between kinematic parameters of players relative to the position were obtained using multivariate analysis of variance (MANOVA). Differences between the1st and 2nd half were obtained using univariate analysis of variance (ANOVA). The Bonferroni post-hoc test showed differences between the mean values. The level of

Table 2. Differences of kinematic parameters of players in relation to position and period of the match

		MS	nAcc	nS	V4	V5
CD	Match	29.9±1.7	**19.7±5.7[e]**	2.6±1.9	341 ± 85.8	100 ± 53.3
	1.Half.	28.9±1.6	10.4±2.5	0.94±0.8	170.2±42	41.5±26.7
	2. Half.	29.4±1.9	9.3±4.5	1.7±1.4	175.5±54.2	61.9±37.3
FB	Match	**30.7±1.1[b]**	**23.6±5.2[e]**	3.9±2.3	480 ± 91.2	159 ± 67.1
	1.Half.	29.8±1.6	12.8±3.6	2±1.6	233.3±55.1	83.9±41.6
	2.Half.	29.4±1.7	10.4±3.1	2±1.6	256±74.9	80.4±52.1
CM	Match	28.8±1.6	13.4±4.5	2.4±1.8	475 ± 133.6	87 ± 56
	1.Half.	27.9±1.7	7.4±3.3	1.2±1.2	263.5±82.9	41.4±30.1
	2.Half.	27.7±2.2	6.2±2.6	1.1±1.1	245.4±88.9	42.7±34.4
WM	Match	**30.5±0.9[b]**	**27.6±6.4[f]**	**6.2±3.3[f]**	677 ± 156	213 ± 104
	1.Half.	**30.4±1.1[a]**	15.3±3.7	3.8±2.5	390.4±86.2	136.2±72.2
	2.Half.	29.2±1.6	12.6±3.9	3±1.8	359.6±93.3	106.7±54.2
FW	Match	27.9±0.7	17.4±2.5	1.8±1.4	429 ± 95.4	59 ± 35.6
	1.Half.	28.5±1.5	7.4±2.9	1.6±1.1	239±36.8	43±25.1
	2.Half.	27.5±1.9	10.4±3	1±1	264±139.4	44.7±26
AS	Match	29.7±1.6	19.9±7.4	3.4±2.77	481± 163	127±85
	1.Half.	29±1.8	10.7±4.4	1.8±1.8	259.6±110.6	68.2±56.6
	2.Half.	28.7±2	9.3±4.1	1.8±1.5	254.7±102.8	67.1±48.1

Legend: Central defenders (CD), Fullbacks (FB), Central midfielders (CM), Wide midfielders (WM) and Forwarders (FW) Maximum speed (MS), number of acccelerations (nAcc), number of sprints (nS), distance of high intensity running ≥19.8 km/h (V4) and sprint distance ≥25.2 km/h (V5)

[a] Difference between 1st and 2nd half (P < 0.05).

[b] Difference between central midfielders and forwarders (P < 0.05).

[c] The difference with respect to the central defenders (P < 0.05).

[d] Difference with respect to all other positions (P < 0.05).

[e] Difference with respect to central defenders (P < 0.05).

[f] Difference with respect to central defenders, central midfielders and forwarders (P < 0.05).

statistical significance was set at p <0.05. All statistical analyzes were performed using the SPSS software package (IBM SPSS Statistics 20. Chicago, IL, USA).

Results

Based on n = 74 individual observations, the results show that players averaged 3.4 ± 2.77 sprints, ran 481 ± 163 m in the high-intensity zone ≥19.8 km / h, and 127 ± 85 m sprint zone ≥25.2 km / h (Table 2). The average maximum running speed during matches was 29.7 ± 1.6 km / h while the number of accelerations was 19.9 ± 7.4 per game.

A statistically significant difference between the 1st and 2nd half was observed only with the variable maximum speed (MS) and only with wide midfielders where players scored higher (MS) in the first half. Further analysis found that fullbacks and wide midfielders reach statistically significantly higher maximum speed at the game compared to central midfielders and forwarders (Table 2).

According to the results obtained, central defenders and fullbacks performed statistically significantly more accelerations relative to central midfield players, while further wide midfielders performed on average more accelerations compared to central defenders, central midfielders, and forwarders (P <0.05), (Graph 1).

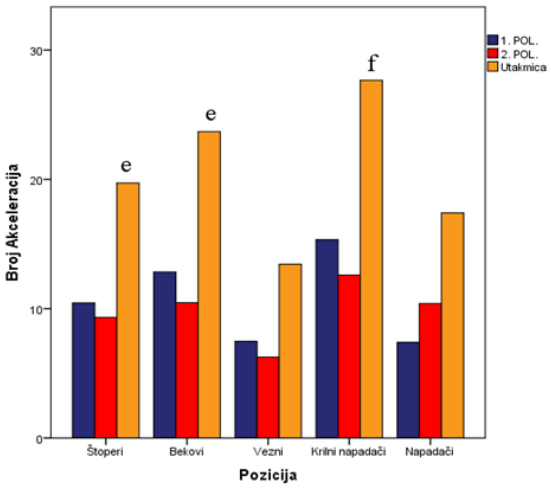
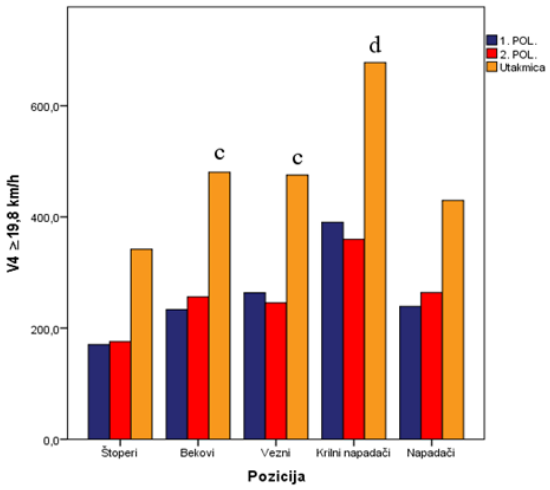
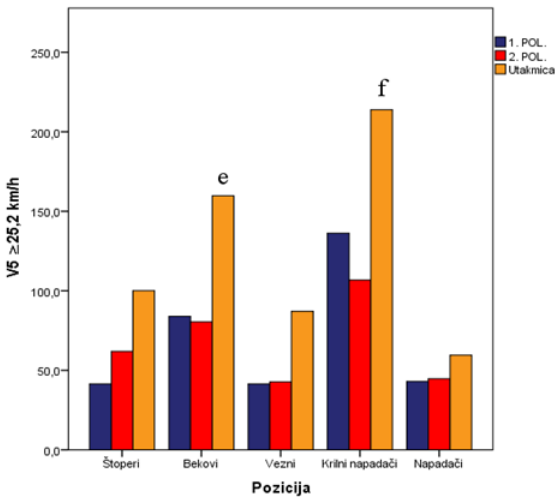


Figure 1. The number of accelerations concerning the period of the game and the position of the player.
[e] Difference with respect to the central midfielders (P <0.05).
[f] Difference with respect to central defenders, central midfielders, and forwarders (P <0.05).

Wide midfielders performed statistically significantly more sprints (6.2 ± 3.3) than other players on the team during the game (P <0.05). Further analysis of the kinematic parameters showed that the fullbacks and central midfielders ran significantly higher in the V4 zone ≥19.8 km / h compared to the central defenders (P = 0.023 and P = 0.008), while the wide midfielders ran significantly higher than all other positions in the team (P <0.01) (Chart 2). Fullbacks crossed the greater distance in the V5 sprint ≥25.2 km / h relative to central midfielders (P = 0.036), while wide midfielders ran more than central defenders, central midfielders, and forwarders (P <0.01) (Graph 3).



Graph 2. High intensity running ≥19.8 km / h relation to the match period and player position.
[c] Difference with respect to central defenders (P <0.05).
[d] Difference with respect to all other positions (P <0.05).



Graph 3. Sprint distance ≥25.2 km / h with respect to match period and player position.
[e] Difference with respect to central midfielders (P <0.05).
[f] Difference with respect to central defenders, central midfielders, and forwarders (P <0.05).

Discussion

Analyzing the data from this paper, the results show that the values of the kinematic parameters of high-intensity movement structures in football obtained during matches differ with respect to the position of players on the field. The same conclusions were drawn (Di Salvo et al. 2010; Dalen et al. 2016; Mohr et al. 2003) based on the results of their research. The average number of sprints in 13 games of the highest ranked competition in Bosnia and Herzegovina was 3.4 ± 2.7 during one game, while the average sprint distance for all player positions was 127 ± 85 m. To compare, the results of the survey (Wehbe et al. 2014; Andrzejewski et al. 2016) show significantly higher numbers when it comes to the number of sprints and the amount of distance traveled in a sprint during an elite players' match than the results obtained by this research. According to (Wehbe et al. 2014), players on the match made an average of 6.9 ± 2.5 sprints and sprinted ≥25.2 km / h in a distance of 200 m, while (Andrzejewski et al. 2016) stated in their work that the average number of sprints was 11.2 ± 5.3 and the distance traveled in the sprint was slightly greater than 237 ± 123 m, but for the purpose of their research, the sprint was considered to achieve speed greater than ≥24 km /h. However, according to a survey (Taylor et al. 2017) stating that the total distance covered in a sprint by elite football players can range up to 117 m and even up to 830 m in a single game. If this is taken into account, the kinematic data of the players of the league of Bosnia and Herzegovina is at the bottom of that scale, which is probably due to the lower quality of players and teams. Respecting the position of players on the field during the match, (WM) fouls averaged more sprints 6.2 ± 3.3 and exceeded the average distance in the sprint, 213 ± 104 m, compared to other player positions, as confirmed by other authors' research on differences between player positions (Di Salvo et al 2009; Harley et al 2010). However, it is interesting that the (FB) have a greater distance in the sprint compared to all other player positions except the (WM). This is probably due to a large amount of effort that the wing and side positions put in both directions of the game and the smaller amount through the middle of the pitch and the deep forward play situations. This may further explain the results obtained in this paper that (CM) and (FW) have a very small average number of sprints and therefore a small distance traveled during a match. The average number of accelerations per match isclosely related to the sprint parameters. Wide midfielders perform a statistically significantly higher number of accelerations compared to other positions 27.6 ± 6.4 during the match. Such claims are also confirmed by (Dalen et al. 2016) with the average number of accelerations according to their research being 76 ± 22.

Analyzing the results of high intensity running ≥19.8 km / h obtained by this study, we found that the situation is similar to that of the sprint parameters. Wide midfielders exceed the highest average distance in this speed zone during the match 677 ± 156 m with a statistically significant difference from other player positions. Also, (FB) and (CM) have statistically significant average values compared to (CD) and even (FW), however, significantly lower values than average values of elite European leagues. Finally, it is interesting that there were no statistically significant differences in kinematic variables between the first and second half at the matches of the League of Bosnia and Herzegovina. The data analyzed indicate that there are large differences in the key kinematic parameters for a football game in relation to the results of the elite leagues of Europe, which is certainly a consequence of the poor quality of the players and teams of the league in which the research was conducted.

Conclusion

This study analyzed the differences between player positions and quantified the physical demands of elite players competing in the highest rank in Bosnia and Herzegovina. Based on the kinematic parameter data, the results show several statistical differences with respect to the position of the player during the match. Differences in kinematic parameters during a match are influenced by the position of the player on the field, technical performance, tactical training, and the quality of the ground on which the game is played. The data presented in this study can serve for future analyzes and comparisons, and represent the scientific basis for constructing and programming specific training exercises in relation to the player position and physical demands of the game. In this paper, a small number of observations were used to generalize the results. However, in the future, it is necessary to analyze a larger sample of respondents and to monitor a larger number of variables that will surely give more detailed information on the kinematic parameters of football players' movement during the match.

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