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Original Article

Speed ability of youth soccer players in the match

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Abstract
In this research, differences in high-intensity activities among youth soccer players were analyzed, particularly the total number of accelerations, total number of sprints, and total sprint distance (>25.2 km/h). In addition, these metrics were compared across different player positions in soccer, including central defender (n = 32), full-back (FB, n = 40), central midfielder (n = 42), wide midfielder (WM, n = 32), and central forward (CF, n = 17). We assumed significant differences in the total distance covered at maximum intensity, the number of runs at maximum intensity, and the number of accelerations among the individual player positions. The sample consisted of the players of ŠK Slovan Bratislava U21. The team plays in the second-highest men's league. We collected the data from 27 matches in the seasons 2021/2022 and 2022/2023. However, we only used the data if the player participated in the entire match. The total number of records was 164. Such data were collected using the Polar Team Pro system. Then, the obtained data were processed and evluated using the Shapiro–Wilk test, one-way ANOVA, and post-hoc Tukey HSD test. We chose a significance level (α) of 0.05. From the measured values, significant differences in total sprint distance ($F = 27.51$, $p < 0.01$), total number of sprints ($F = 23.94$, $p < 0.01$), and total number of accelerations ($F = 6.45$, $p < 0.01$) were found among player positions. FB and WM achieved the highest total sprint distance and total number of sprints. By contrast, WM and CF achieved the highest total number of accelerations.
Key words: **players' positions, total sprint distance, total number of sprints, total number of accelerations, external load**

Introduction

Soccer, by its structure, is one of the sports that requires players to maximally display individual speed abilities in constantly changing game conditions (Buchheit et al. 2021). The variability and diversity of game conditions form one of the key factors influencing specific soccer performance. Holienka (2004) states that one of the main characteristics of modern elite soccer is the constant increase in demands on players' speed abilities, whether in individual or collective game expression (Bradley 2024). Soccer coaches must thus prepare players in the training process to meet these increasing demands.

Bate & Jeffreys (2015) claim that the demands for speed are specific in soccer because the player acts in open space and in constantly changing game conditions. Therefore, the resolution of a specific game situation always influences a player's speed performance in a match. According to Faude et al. (2012), sprinting is the primary action that takes place prior to a goal's scoring. This requires players to be able to constantly anticipate and be ready to react in different directions with adequate speed and movement control. Comprehensively developed speed in soccer involves an optimal level of all types of speed abilities; therefore, to achieve their comprehensive development, it is necessary to pay sufficient attention to each manifestation in the training process (Holienka 2004).

One of the reasons why sports scientists and fitness coaches in today's soccer focus on how many meters a player covers in high intensity is that HID (high intensity distance) or SD (sprint distance) is a better indicator of performance than a total distance run per game because it has a strong correlation to a player's physical capacity (Bradley et al. 2011).

In our research, we based our model on the same structure of the players' positions used by Bradley et al. (2009), Di Salvo (2009), Dellal et al. (2011), Ade et al. (2016), Baptista et al. (2018), Malý (2020) or Mitrotasios et al. (2024) in their works: full-back (FB), central defender (CD), central midfielder (CM), wide midfielder (WM), and central forward (CF).

The acceleration and sprint profiles of soccer players show significant differences depending on their playing positions, reflecting the specific physical demands of matches for each role. For instance,

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wide midfielders (WM) cover higher acceleration and deceleration distances compared to central defenders (CD), and they also achieve higher maximum speed performance (32.0 km.h^{-1} versus 30.6 km.h^{-1} for CD) (Oliva-Lozano et al. 2020). These findings align with evidence that sprinting performance is crucial for the success of game actions, such as goal scoring or creating scoring opportunities (Rey et al. 2024). Additionally, training interventions targeting short- and long-sprint distances have demonstrated performance improvements across various sprint sections, with long-sprint training showing slightly superior improvements in agility and overall performance (Rey et al. 2024). These variations between players in different positions and training types highlight the need for individualized training programs tailored to optimize players' physical performance (Janusiak et al. 2024).

In their research, numerous other authors have examined the impact of match loads on speed performances through the lens of player positions. Ryan (2021) states that the player position of full-back (FB) is characterized by the requirement for a high volume of total distance runs and high-intensity activities. Bradley et al. (2009) addressed the investigation of players' fitness profiles in terms of accelerations and sprinting during a match. They found that the total distance covered in a match in this player's position averages 10 710 ±589 m. Of this, 984 ±195 m is covered by the full-backs at submaximal intensity and 287 ±98 m at maximal intensity. At the same time, Rampinini et al. (2007) add that, compared to central midfielders and central defenders, full-backs spend 23% and 42% more time, respectively, in the speed zone of maximal intensity.Ingebrigtsen et al. (2014) reported 95 ±19.4 accelerations for full-backs. At the same time, they add that the full-backs, just after the wide midfielders, cover the highest distance at maximum intensity (> 25.2 km.h^{-1}) in a match at 284 ±123 m split into 20.9 ±8.2 runs.

The player position of central defender places the lowest demands on both the total distance covered and the total distance covered by maximal and submaximal intensity (Dellal et al. 2011; Bradley et al. 2009). Malý (2020), comparing individual player positions, reported a total distance covered of 9 910.3 ±606.9 m for the central defenders, which was significantly less compared to the other player positions. The study also recorded the same results for the total distance covered by submaximal intensity (> 19.8 km.h^{-1}) and maximal intensity (> 25.2 km.h^{-1}). There, the central defenders achieved values of 451.9 ±114.3 and 79.7 ±38.8 m, respectively. Ryan (2021) justifies the lower requirements for this player position by the fact that central defenders only necessarily leave the dense central vertical of the pitch during opponents' counterattacks, when they protect the full-back. Most of the time, the central defender defends the space from his goal to the middle of the pitch, which tends to be more dense than wide verticals. Therefore, the requirements for central defenders are primarily focused on their ability to accelerate and decelerate quickly at close range, as well as developing a high top speed to thwart an opponent's quick counterattack. Holienka (2005) further emphasizes that among fitness abilities, central defenders must possess reaction, starting, and acceleration speeds to effectively tackle and transition from the defensive zone to the middle zone.

Ryan (2021) states in his paper that spatially the wide midfielder covers almost the same space as the full-back, but by performing specific tasks and tactical intentions of the coach, we can see more distance covered in this position at high intensities. By fulfilling specific tasks and tactical intentions of the coach, he can record a higher distance covered in high intensities. This statement is supported by the research of Malý (2020), who recorded the highest distance covered in submaximal and maximal intensities for wide midfielders at 995.0 ±266.3 m and 252.0 ±120.9 m, respectively. Bradley et al. (2009) measured in elite wide midfielders an average distance covered of 1 214 ±251 m in high-intensity running (> 19.8 km.h^{-1}). In terms of the demands on this player position, Ingebrigtsen et al. (2014) reported that wide midfielders perform the highest number of accelerations (105.5 ±22.2) and also stretches at maximum intensity (23.2 ±6.8) among all player positions in a match. Andrzejewski et al. (2013) analyzed the number of maximum intensity runs and the total distance covered in this speed zone. They found that wide midfielders perform 14.9 ±44.9 maximum intensity runs in a match, of which 13.6 ±4.1 runs are under 5 seconds in duration, with more than 90% of these runs being longer than 10 m.

We consider the central midfielder position, together with the wide midfielder, to be the most demanding in terms of player fitness requirements. This position requires the player to perform numerous tasks in both attacking and defending across a large area, leading to numerous accelerations and decelerations during play. This fact is confirmed by Malý (2020), who states in his work that the central midfielder completes the highest number of accelerations and decelerations during a match, simultaneously covering the highest total distance and performing the most activities with high metabolic effort. Bradley et al. (2009), who compared the external load on individual player positions, found that the central midfielder covers an average total distance of 11 450 ±608 m during a match, of which 927 ±245 m are submaximal intensity runs (> 19.8 km.h^{-1}) and 204 ±89 m are maximal intensity runs (> 25.2 km.h^{-1}). Di Salvo et al. (2007) add that the central midfielder also covered the highest distance in the 11.1 to 19.0 km.h^{-1} speed zone compared to other players.

Bradley et al. (2009) for the central forwards in their work report an average total distance covered of 10 314 ±1175 m, of which 955 ±239 m is submaximal-intensity running. Di Salvo et al. (2009) further complement this and report that central forwards cover the highest distance of all player positions, 566 ±104 m, at submaximal intensity (> 19.8 km.h^{-1}) in the attacking phase of the game. In contrast, they overcome the

smallest distance in this speed zone (331 ±83 m) in the defensive phase of the game. Andrzejewski et al. (2013), by examining players' speed performance in UEFA European league matches, found that among all player positions, central forwards covered the highest distance at maximum intensity (345 ±129 m) and the highest number of runs at maximum intensity at 15.9 ±5.1, of which the most runs were longer than 10 m.

Modern soccer is characterized by high intensity regarding motor and physiological parameters, as well as technical and tactical skills. However, we can assert that soccer players' efforts during matches vary depending on the characteristics of their positions. Therefore, it is crucial to evaluate each player's physical, physiological, and motor parameters to monitor their performance and create customized training plans that meet their positional requirements (Aksoy et al. 2024).

The digital revolution has brought new possibilities and approaches to the monitoring of players' game expression in a soccer match (Memmert & Rein 2018). Recent research in the monitoring of physical demands in professional soccer has focused on the accuracy and reliability of technologies such as global navigation satellite systems (GNSS) and optical-tracking systems. Comparative studies between these systems have demonstrated strong correlations and good-to-excellent agreement in measuring total distance covered (ICC = 0.974) and sprint distance (ICC = 0.822) during matches. However, GNSS often underestimates values compared to optical-tracking systems, particularly in high-speed running and sprint distances (Makar et al. 2023). People commonly use absolute velocity thresholds (> 25.2 km/h) to classify sprints, but players are increasingly focusing on individualized thresholds that take into account their maximum velocities. This approach has proven more accurate in differentiating between starters and substitutes during competitive periods (Gualtieri et al. 2023; Silva et al. 2024). Moreover, systematic reviews highlight the variability in velocity thresholds used across studies, emphasizing the need for standardization in this area to facilitate better comparisons between clubs and research studies (Gualtieri et al. 2023).

Currently, these technologies make it possible to record every player's expression on the pitch and have equally become an important part of the training process across all ages and performance levels. Malý (2020) adds that among the main objectives of monitoring players, whether during matches or the training process, is to optimize the external and internal load, leading to injury prevention, application of the principle of individualization of training load, clarification of factors affecting individual and team game performance, and, last but not least, talent identification.

Materials and Methods

Objective

The aim of the research was to contribute to the expansion of knowledge on the application of selected expressions of speed abilities of junior category players in competitive soccer matches.In competitive soccer matches involving junior category players, we assumed varying performance levels of selected speed expressions, considering the specificity of individual player positions. We assumed significant differences between
the individual player positions in the total distance covered by maximum intensity, in the number of runs by maximum intensity, and in the number of accelerations.

Participants

The research participants consisted of 30 players of the ŠK Slovan Bratislava U21. We selected the player positions: central defender (CD, n = 32), full-back (FB, n = 40), central midfielder (CM, n = 42), wide midfielder (WM, n = 32) and central forward (CF, n = 17). The sample consisted of players of ŠK Slovan Bratislava U21. The team plays in the second-highest men's league. We collected the data from 27 matches in the seasons 2021/22 and 2022/23. We only used the data if the player participated in the entire match. The total number of records
was 164.

Procedures

We used the measurement method to collect the data. We recorded the match load of players during league matches by using a Polar Team Pro GPS monitoring device.Among the numerous speed load parameters offered by the Polar Team Pro system, we concentrated on the following speed parameters related to player movement during the match:

- total sprint distance (> 25,2 $km.h^{-1}$) [m],
- total number of sprints [n],
- total number of accelerations [n].

Statistical analysis

We used the Shapiro–Wilk test, one-way ANOVA and post-hoc Tukey HSD test to process and evaluate the obtained data. We chose the level of statistical significance $\alpha = 0.05$.

Results

We found significant differences in total sprint distance (> 25.2 km.h^{-1}) (F = 27.51, p < 0.01), total number of sprints (F = 23.94, p < 0.01), and total number of accelerations (F = 6.45, p < 0.01) between the different player positions. FB and WM ran the highest total sprint distance (> 25.2 km.h-1) and also achieved the highest total number of sprints. WM and CF achieved the highest total number of accelerations (Table 1).

Table 1. ANOVA monitored parameters depending on player position

Variable	Playing position					p
	CD	ED	CM	EM	CF	
Total sprint distance (> 25.2 km/h) [m]	102.55 ±55.37	240.85 ±78.92	140.98 ±77.31	238.19 ±79.81	124.88 ±46.09	< .01**
Total number of sprints	9.39 ±3.43	17.23 ±4.41	11.21 ±5.15	17.69 ±5.16	12.29 ±2.78	< .01**
Total number of accelerations	106.88 ±14.24	128.25 ±25.15	122.57 ±27.27	132.31 ±13.92	131.65 ±32.14	< .01**

In total sprint distance (> 25.2 km.h^{-1}), we found significantly higher distance run in FB compared to CD, CM, and CF. Similarly, WM ran significantly more in total sprint distance (> 25.2 km.h^{-1}) than CD, CM, and CF. We did not find significant differences between FB and WM. Similarly, we did not find significant differences between CD, CM, and CF (Table 2).

Table 2. Total sprint distance depending on playing position

Total sprint distance (> 25.2 km/h) [m]		CD	ED	CM	EM	CF
CD	mean difference	-	-138.30	-38.43	-135.64	-22.33
	p	-	< .001**	0.149	< .001**	0.835
ED	mean difference		-	99.87	2.66	115.97
	p		-	< .001**	1.000	< .001**
CM	mean difference			-	-97.21	16.10
	p			-	< .001**	0.936
EM	mean difference				-	113.31
	p				-	< .001**
CF	mean difference					-
	p					-

FB had a significantly higher total number of sprints than CD, CM, and CF. Similarly, WM achieved a significantly higher total number of sprints compared to CD, CM, and CF. We did not find significant differences between FB and WM. Similarly, we did not find significant differences between CD, CM, and CF (Table 3).

Table 3. Total number of sprints depending on playing position

Total number of sprints		CD	FB	CM	WM	CF
CD	mean difference	-	-7.83	-1.82	-8.30	-2.90
	p	-	< .001**	0.405	< .001*	0.195
FB	mean difference		-	6.02	-0.46	4.94
	p		-	< .001**	0.992	0.002**
CM	mean difference			-	-6.48	-1.08
	p			-	< .001**	0.917
WM	mean difference				-	5.40
	p				-	< .001*
CF	mean difference					-
	p					-

We found a significantly lower total number of accelerations in CD compared to FB, CM, WM, and CF. We did not observe significant differences between the other player positions (Table 4).

Table 4. Total number of acceleration depending on playing position

Total number of accelerations		CD	FB	CM	WM	CF
CD	mean difference	-	-21.37	-15.69	-25.43	-24.77
	p	-	0.001**	0.031*	< 0.001**	0.004**
FB	mean difference		-	5.68	-4.06	-3.40
	p		-	0.797	0.946	0.986
CM	mean difference			-	-9.74	-9.08
	p			-	0.375	0.646
WM	mean difference				-	0.66
	p				-	1.000
CF	mean difference					-
	p					-

Discussion

The significant differences between player positions whose radius of action is predominantly in the middle vertical (CD, CM, CF) and player positions that are in the extreme verticals (CD and FB) are fully consistent with the roles that are inherent in these player positions. The abundance of players in specific areas of the pitch also has a significant influence. The middle vertical is the busiest in terms of player density, meaning that players rarely reach submaximal or maximal sprints. In these spaces, there is a greater potential for high-intensity changes in the direction of players' running, or acceleration or deceleration (Martin-Garcia et al. 2018). However, our prediction that player positions in the mid-vertical should have a higher frequency of accelerations was not confirmed (Table 4).

In CF, we found the second highest frequency of acceleration (131.65). This is due to repeated accelerations behind the opponent's defensive line or into open spaces. Often, during these accelerations, players change their running direction to gain an advantage over their opponent and create a time and space deficit. Martin-Garcia et al. (2018) or Passos Ramos et al. (2019) found that CFs and CDs achieve a lower frequency of accelerations than FBs and WMs in matches. Especially for the CF player position, this is in contrast with our findings. This could potentially be attributed to multiple factors. One of them is the opposing team and the level of competition; the other may be the different tactical (game) roles for specific player positions.

Players in the wide verticals (FB and WM) achieved significantly higher values in total sprint distance. This is a development where FBs, in particular, strongly support the offense and are able to cover more ground. Naturally, their role as a defender prioritizes preventing the opponent from concluding the offensive phase of the game. If players carry out these tasks responsibly, not only should their total distance covered reach the highest values among all player positions, but also their sprint distance. In our research, we focused on running with maximum intensity.

One subject for future investigation of player positions and high-intensity actions overcome in a match could be their comparison between winning and losing a match. As reported by Andrzejewski et al. (2016, 2017), CBs and WBs overcame shorter high-intensity distances in won matches than in lost matches. Conversely, FB and WM managed to overcome longer high-intensity distances in won matches compared to lost ones. This only confirms that players who are physically prepared to repeat high-intensity runs are more likely to successfully complete the match, but further research is necessary to validate this hypothesis.

The findings could aid coaches in comprehending the specificity of match load based on player differences. Coaches can use our findings to better model the training process's content, with a focus on individual player specificity. We also confirmed a trend about player positions in the wide verticals, which are the most demanding in terms of energy coverage during high-intensity activities. The scouting department of a soccer club can use the results of our work as a selection criterion to identify new potential players for specific player positions.

Conclusions

We found significant differences between the individual player positions in the study set. In terms of the high-intensity game activities we analyzed, the full-backs and wide midfielders are the most demanding player positions. Players in these player positions achieved statistically significantly the highest number of sprints and the highest total sprint distance (> 25.2 $km.h^{-1}$).

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