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POSITIONAL VARIATIONS IN HIGH-INTENSITY ACTIONS AND WORKLOAD AMONG U14 ELITE FOOTBALL PLAYERS: A PERFORMANCE ANALYSIS

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Abstract

The analysis of positional differences in youth football provides valuable insights into player workload and match performance. This study examines the U14 Elite League, focusing on four key performance indicators: power plays, work ratio, accelerations (≥ 4 m/s²), and decelerations (≥ 4 m/s²). The research aims to determine whether significant differences exist between defenders, midfielders, and forwards based on these metrics. Data collection was conducted over 15 matches using the Catapult One system, with analysis limited to the first half due to equipment constraints. Results indicate that midfielders recorded the highest work ratio, emphasizing their continuous involvement in transitions. Forwards demonstrated significantly higher power plays and accelerations, confirming their role in offensive bursts. Defenders exhibited the most decelerations, highlighting their need for quick stops and defensive adjustments. Statistical analysis confirmed significant differences in multiple indicators, partially validating the research hypothesis. The findings reinforce the necessity of position-specific training programs to enhance performance and reduce injury risk. Future studies should investigate full-match workloads, examine tactical variations, and compare performances on different pitch sizes to further contextualize these results in youth football development.

Introduction

Understanding positional workload differences is essential for optimizing training and recovery strategies in youth football. This study focuses on analyzing external load distribution among defenders, midfielders, and forwards, using key indicators such as power plays, work ratio, and high-intensity accelerations and

decelerations (≥ 4 m/s²). While wearable tracking systems like Catapult provide precise data, traditional methods relying only on speed and distance may underestimate actual player exertion, as high-intensity efforts often occur even at lower speeds [8, 11].

Research shows that accelerations and decelerations contribute significantly to overall player workload, making up 12-17% of total load [13].Comparisons between speed-based and acceleration-based monitoring reveal discrepancies of 6-8% in total load estimations, reinforcing the need for detailed assessment of rapid velocity changes [8, 11]. These movements impose unique biomechanical and physiological stress, requiring position-specific adaptation strategies [14].

Unlike previous studies that analyzed movements above 3 m/s² or 3.5 m/s² [1, 10], this research exclusively examines accelerations and decelerations ≥ 4 m/s², offering a more targeted approach to extreme-intensity actions.

A key distinction of this study lies in the modified pitch dimensions of the U14 Elite League in Romania, which differ from international standards. Since 2023, the Romanian Football Federation (FRF) has regulated U14 matches on a 70m x 60m field instead of the standard 100m x 64m dimensions. This significantly alters positional workload distribution, as players compete in a more congested space. On this modified field, each field player operates within 200 m², compared to approximately 305 m² per player on a standard U14 pitch. This difference likely increases match intensity, frequency of accelerations, and rapid positional adjustments.

Analyzing power plays—which reflect high-intensity explosive movements—and work ratio, which represents the proportion of active exertion, provides essential insights into how positional roles affect external load in match conditions. By focusing on these metrics, this study aims to bridge existing gaps in youth football research and enhance training methodologies for position-specific workload management.

Material-method

Participants

This study involved a total of 19 athletes registered with Dinamo Academy 1948 Bucharest, all of whom participated in the U14 Elite League. The team primarily utilized a 4-3-3 formation, with a single match played in a 3-4-3 system. Players were categorized based on their field positions into defenders, midfielders, and forwards. The defensive line consisted of full-backs and center-backs, while the midfield unit included both defensive and attacking midfielders. The offensive group comprised wingers and a central forward.

Over the course of 15 matches, 146 recordings were gathered: 57 from defenders, 46 from midfielders, and 43 from forwards. Some discrepancies in data collection resulted from technical issues affecting match 4 and a tactical adjustment

implemented in match 8. To facilitate this research, a collaborative agreement was established between Dinamo Academy 1948 Bucharest and the National University of Physical Education and Sports (UNEFS). As the team's head coach, Vicol Sebastian supervised the entire study. Written consent was secured from parents for all participants, ensuring compliance with ethical research guidelines.

Equipment

For performance tracking, the Catapult One system was employed. This technology integrates lightweight GPS-based sensors embedded in vests worn by players, allowing for the collection of various performance metrics. These sensors utilize accelerometers, gyroscopes, and magnetometers to register data with high precision, capturing details such as movement patterns, intensity levels, and workload. Additionally, the system generates post-match analytical reports, enabling coaches to assess player performance and refine training strategies accordingly [5].

Performance Metrics

The following four performance indicators were analyzed using the Catapult One system:

Power Plays – This metric quantifies the number of explosive actions performed at high intensity during a match. It includes rapid accelerations, high-speed running, and sudden bursts of movement, providing insight into an athlete's ability to execute game-changing plays [6].

Work Ratio – This indicator represents the relationship between intensity of effort and match duration. It reflects the balance between exertion and recovery, helping coaches optimize workload distribution and prevent early fatigue [9].

Number of Accelerations ≥ 4 m/s² – Accelerations refer to rapid increases in velocity over a short period. A threshold of 4 m/s² was used, which translates to a speed gain of approximately 14.4 km/h within one second. Frequent accelerations indicate a player's ability to initiate quick movements, escape pressure, and create offensive opportunities [4].

Number of Decelerations ≥ 4 m/s² – Decelerations capture instances where players rapidly reduce speed. This threshold of 4 m/s² corresponds to a loss of 14.4 km/h in one second. High deceleration counts reflect an athlete's ability to stop efficiently, change direction, or adjust positioning in response to dynamic match situations [7].

Procedure

The study was conducted during the U14 Elite League, Series 2, spanning September 2023 to May 2024. Data was gathered exclusively from the final 15 matches of the season, as monitoring equipment was unavailable for the initial rounds.

Before each match, 10 Catapult vests were allocated to the starting players, excluding the goalkeeper. Due to equipment constraints, substitute players were not monitored, and analysis was limited to the first half of each match (35 minutes).

Following every game, data was extracted from the Catapult system, with relevant performance indicators selected for detailed evaluation.

Data Analysis

A t-test was employed to determine statistical differences between defenders, midfielders, and forwards concerning the selected performance metrics. This statistical method was chosen for its effectiveness in comparing mean values across independent groups.

Limitations

One of the key limitations of this study was the restriction of data collection to the first half of matches, as only 10 Catapult vests were available. Consequently, players who entered the game as substitutes were not monitored, potentially affecting the ability to assess full-match performance. Future research should aim to track entire matches, allowing for a more comprehensive analysis of workload distribution, endurance capacity, and tactical adaptations across both halves of play.

Results

Table 1 illustrates the results recorded by Defenders, Midfielders, and Forwards in terms of Power Plays, Work Ratio, Number of Accelerations greater than 4 m/s², and Number of Decelerations greater than 4 m/s².

Table 1. Results recorded by forwards, defenders and midfielders in terms of Power plays, Work ratio, Accelerations greater than 4 m/s² and Decelerations greater than 4 m/s².

Position		Power plays	Work ratio	Acceleration	Deceleration
F	Mean	18.16	36.568053	8.33	12.44
	N	43	43	43	43
	Std. Deviation	6.704	5.1305442	3.496	6.15
D	Mean	15.93	39.663939	5.54	9.3
	N	57	57	57	57
	Std. Deviation	7.221	5.1077383	3.196	4.452
M	Mean	14.13	41.99477	5.04	9.41
	N	46	46	46	46
	Std. Deviation	6.622	8.5628755	3.231	4.313
Total	Mean	16.02	39.486508	6.21	10.26
	N	146	146	146	146
	Std. Deviation	7.019	6.707433	6.659	5.411

Power Plays

In terms of high-intensity actions (power plays), forwards recorded the highest values, with an average of 18.2 power plays per match. In contrast, defenders

averaged 15.9, while midfielders registered the lowest count at 14.1. Statistically, forwards performed a significantly higher number of power plays compared to midfielders (28% more, p-value = 0.005, Table 2). However, the differences between forwards and defenders, as well as between defenders and midfielders, were not statistically significant (p-value = 0.118 and p-value = 0.195, Table 2)

Work Ratio

Regarding work ratio, midfielders exhibited the highest workload, averaging 41.9%, followed by defenders at 39.6%, and forwards at 36.5%. Statistical analysis confirmed that midfielders maintained a significantly greater work ratio than both defenders (6% higher, p-value = 0.09, Table 2) and forwards (15% higher, p-value < 0.001, Table 2). These results indicate the increased physical demands placed on midfielders due to their extensive involvement in both offensive and defensive phases of play.

Accelerations and Decelerations ≥ 4 m/s²

Forwards recorded the highest number of accelerations and decelerations above 4 m/s², reflecting the dynamic nature of their role, which involves frequent high-intensity movements to evade defenders and create scoring opportunities.

Forwards vs. Defenders: Forwards performed 50% more accelerations above 4 m/s² (p-value < 0.001) and 33% more decelerations above 4 m/s² (p-value = 0.007) than defenders.

Forwards vs. Midfielders: Forwards registered 65% more accelerations above 4 m/s² (p-value < 0.001) and 32% more decelerations above 4 m/s² (p-value = 0.014) than midfielders.

Midfielders vs. Defenders: No statistically significant differences were observed in the number of high-intensity accelerations and decelerations between these two groups (p-value > 0.05, Tables 2).

These findings highlight the positional demands of football, with forwards displaying the most frequent high-intensity movements, requiring greater acceleration capacity and abrupt decelerations compared to other positions.

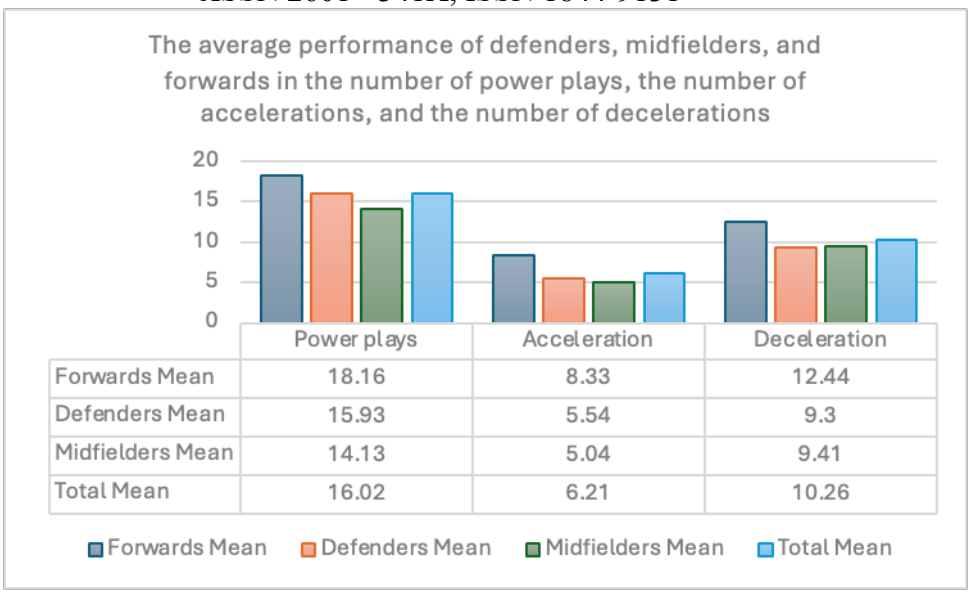

Fig. 1. The average performance of defenders, midfielders, and forwards in the number of power plays, the number of accelerations, and the number of decelerations.

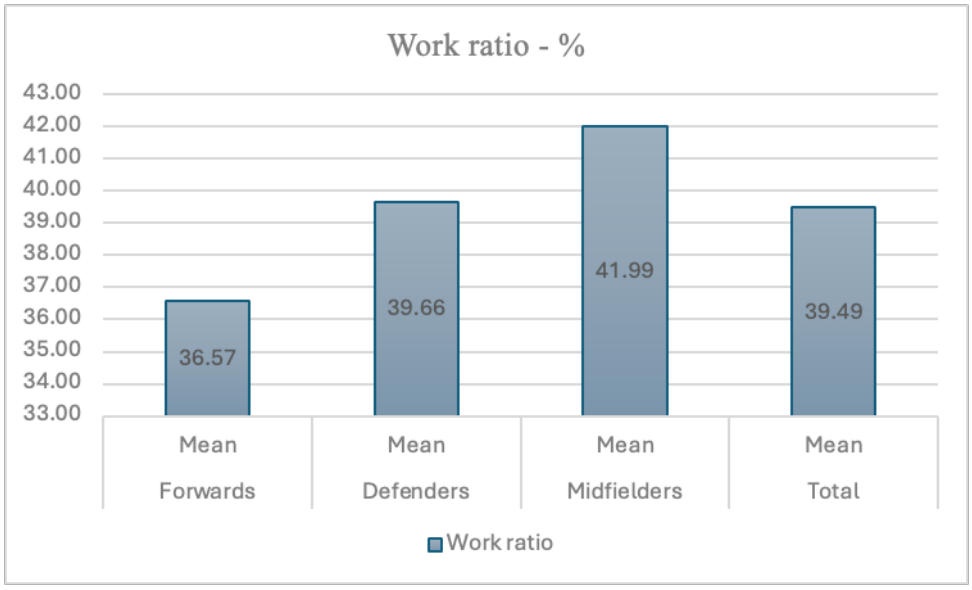

Fig. 2. The average work ratio (%) of defenders, midfielders, and forwards.

Table 2. Statistical comparison of performance indicators between defenders, midfielders, and forwards

Comparison	Indicator	p-value	Mean Difference	Std. Error
Defenders vs. Midfielders	Power Plays	0.195	1.799	1.38
Defenders vs. Midfielders	Work Ratio	0.09	-2.330831	1.3607188
Defenders vs. Midfielders	Acceleration	0.434	0.5	0.637
Defenders vs. Midfielders	Deceleration	0.895	-115	0.87
Defenders vs. Forwards	Power Plays	0.118	2.233	1.415
Defenders vs. Forwards	Work Ratio	0.003	-3.095885	1.0336852
Defenders vs. Forwards	Acceleration	0	2.782	0.672
Defenders vs. Forwards	Deceleration	0.007	3.144	1.139
Midfielders vs. Forwards	Power Plays	0.005	4.032	1.413
Midfielders vs. Forwards	Work Ratio	0.001	-5.426716	1.5093805
Midfielders vs. Forwards	Acceleration	0	3.282	0.713
Midfielders vs. Forwards	Deceleration	0.014	3.029	1.213

Discussions

In modern football, the ability to analyze and quantify positional differences is essential for optimizing player development and tactical strategies. The U14 Elite League, introduced by the Romanian Football Federation (FRF) in the 2023-2024 season, follows a distinct set of regulations, particularly in terms of pitch size (70m x 60m), match duration (70 minutes, divided into two halves), and team composition (11 vs. 11 players). These elements distinguish it from other youth leagues worldwide, where larger fields are often used.

The findings of this study align with previous research in youth football, which suggests that positional differences impact key performance metrics. Midfielders consistently demonstrate the highest work ratio, confirming their dominant involvement in ball circulation and defensive recoveries. Studies have shown that midfielders cover a greater total distance, reinforcing their role as transitional players [2, 12].

On the other hand, forwards recorded the highest number of power plays and high-intensity accelerations, a result that matches findings emphasizing the explosive nature of attacking players [3, 15]. These actions are critical for penetrating defensive lines, creating scoring opportunities, and responding to quick tactical shifts.

Interestingly, defenders exhibited the greatest number of decelerations, which suggests an increased frequency of reactive movements required to neutralize opposition attacks. This observation is consistent with findings describing how defensive players often perform abrupt stops and changes in direction to maintain optimal positioning [7].

The practical relevance of these findings lies in designing training regimens tailored to each position: Midfielders require a high aerobic capacity and endurance training to sustain their workload throughout the match. Forwards benefit from explosive drills and sprint training to enhance their ability to engage in rapid, high-intensity actions. Defenders should focus on reactivity, agility, and braking techniques to improve their effectiveness in positional play.

By structuring physical preparation based on these positional demands, coaches can improve match performance, injury prevention, and overall player development.

The hypothesis proposed in this study suggested that statistically significant differences exist between defenders, midfielders, and forwards in key performance indicators. The results partially confirm this hypothesis, as some differences were found to be statistically significant, while others did not reach the threshold for significance: Power Plays: Significant differences were found between forwards and midfielders (p-value = 0.005), but not between defenders and midfielders. Work Ratio: Midfielders demonstrated a significantly higher work ratio than both defenders and forwards, confirming their role as high-workload players. Accelerations and Decelerations: Forwards exhibited substantially more high-intensity accelerations and decelerations than both midfielders and defenders (p-value < 0.001), reinforcing the notion that attackers operate at greater intensity levels.

While this research provides valuable insights into positional differences in youth football, several limitations should be acknowledged: Restricted to First-Half Data – Due to equipment constraints, only the first half of each match was analyzed. Future studies should examine full-match performance to assess second-half fatigue effects. Unique Pitch Size – The 70m x 60m field size is not standard for U14 international tournaments, which may limit the generalizability of results when comparing to players on larger pitches. Single-Team Sample – All data was collected from one team, which does not account for tactical variations or different playing styles across multiple squads.

To address these limitations and expand upon these findings, future research should: Compare teams playing on fields of different dimensions to determine how pitch size influences movement patterns and match intensity. Analyze full-match data to evaluate endurance and workload changes between the first and second halves. Increase the sample size by studying multiple teams with varying tactical approaches. Incorporate physiological monitoring to assess the impact of positional demands on player fatigue and recovery strategies. By integrating these aspects into future studies, researchers can gain a more comprehensive understanding of positional-specific demands in youth football and refine training methodologies accordingly.

Conclusions

This study investigated the differences in performance metrics between defenders, midfielders, and forwards in the U14 Elite League, analyzing power plays, work ratio, accelerations ≥ 4 m/s², and decelerations ≥ 4 m/s². The results confirmed that positional roles significantly influence match demands, with midfielders displaying the highest work ratio, forwards performing the most high-intensity actions, and defenders executing more decelerations.

These findings emphasize the importance of individualized training programs based on positional requirements:

Midfielders need high-endurance conditioning to support their continuous movement and involvement in transitions.

Forwards benefit from speed and acceleration drills to enhance their ability to break through defensive lines.

Defenders require agility and rapid deceleration training to optimize their reaction time and positioning in defensive duels.

Given the unique constraints of this study, future research should:

Investigate full-match workload variations, particularly second-half fatigue effects.

Examine teams playing on standard (70m x 60m) U14 fields to determine whether field size influences match intensity.

Expand the sample size by including teams with different tactical approaches to improve the generalizability of the results.

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