

Relationship between selected attacking performance indicators and match dynamics in the FIFA U-20 World Cups 2019 and 2023

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Abstract:

Youth football plays a crucial role in talent development and tactical evolution, with international tournaments like the FIFA U-20 World Cup showcasing emerging players and innovative strategies. Despite the increasing emphasis on youth football as a talent pipeline, comprehensive analyses of goal-scoring patterns in age-specific tournaments remain limited. In addition, comparing play patterns between World Cup editions may be necessary for understanding playing approaches. This study examines key performance indicators (KPIs) influencing match outcomes in the 2019 and 2023 youth tournaments, focusing on goal-scoring patterns and tactical trends. Utilizing notational analysis, data from 104 matches and 307 goals were analyzed across seven KPIs: goal-scoring zones, assist locations, passing sequences, goal timing, scorer and assist provider positions, goal-scoring mechanisms, and types of play (open play vs. set pieces). Statistical analyses, including independent t-tests and Pearson's Chi-Square tests, evaluated inter-tournament differences and associations between KPIs and match outcomes. Results revealed that Position 2 (box inside the penalty area) was the predominant goal-scoring zone, while Position 12 (edge outside the penalty area) increased from 8.5% of goals in 2019 to 14.9% in 2023. Position 5 (centre just outside the penalty area) emerged as the primary assist zone in 2023. Headed goals increased significantly from 15.0% to 23.4%, indicating a shift toward aerial strategies. A decline in long-passing sequences highlighted a trend toward direct attacking play, with open play dominating scoring and set-piece contributions marginally decreasing. Notably, goals peaked in the 76–90+ minute interval, with goal timing in 2019 and goal-scoring mechanisms in 2023 showing significant associations with match outcomes. These findings clarify evolving tactical dynamics in elite youth football, offering evidence based on specific indicators such as goal timing and goal-scoring mechanisms. This study informs coaches' understanding and approach toward attacking and defensive strategies based on game situations and match timelines by delineating critical scoring zones, assist patterns, and strategic shifts. Further investigation should focus on the influence of defensive strategies and goalkeeper performance on goal-scoring patterns, as well as changes in attacking tactics and player positioning.

Keywords: Youth football, performance analysis, goal-scoring zones, tactical trends, football attributes

Introduction

Performance analysis in football provides precise, clear, and objective insights to players and coaches, assisting in improving and optimizing team performance. The amount of research on match analysis in football has expanded as there is a rise in the large volume of data collected (Goes et al., 2021). Goal-scoring patterns have been extensively studied at the elite senior level in football across various tournaments, e.g., the FIFA World Cup (Degrenne & Carling, 2024; Iván Baragaño et al., 2024, Çobanoğlu, 2019; Dufour et al., 2017), the European Championship (Codina, J. S et al, 2024, Michailidis et al, 2018), the English Premier League (Durlik & Bieniek, 2014; Penn & Berridge, 2019; Zhao & Zhang, 2019), and other leagues (Ahmad et al., 2020; Alberti et al., 2013; Eusebio et al., 2025; Mitrotasios et al., 2019). These studies reveal key patterns, such as the dominance of open play in goal-scoring, with over 75% of goals coming from this style of play in World Cup competitions (Dufour et al., 2017). Spatial analyses highlight the effectiveness of central areas within the penalty box, with Çobanoğlu (2019) reporting that 84% of goals during the 2018 FIFA World Cup were scored from this zone. Furthermore, temporal analyses indicate that most goals occur in the final 15 minutes of matches, attributed to defensive fatigue and increased attacking intensity (Kubayi et al., 2020). These works underscore the focus on adult competitions, leaving goal-scoring trends in youth tournaments comparatively underexamined. The study of situational efficiency in football, particularly at the youth international level, has gained increasing attention due to its implications for talent identification, tactical preparation, and performance improvement (Sarmiento et al., 2024; Yi et al., 2018). Attacking Performance Indicators (APIs), such as accurate passes,

progressive passes, successful dribbles, and accurate long balls, are essential metrics that reflect a team's offensive capabilities and are often linked to match outcomes (Branquinho et al., 2025; Miswan et al., 2018; Liu et al., 2015). However, the relationship between these APIs and match dynamics encompassing situational factors like opponent strength, match phase, and possession patterns remains underexplored, especially in high-stakes youth tournaments such as the FIFA U-20 World Cup.

Recent research has revealed positional differences in situational efficiency among elite youth football players, showing that attacking roles (e.g., forwards and midfielders) exhibit distinct patterns in APIs compared to defensive positions (Marasović et al., 2025; Altmann et al., 2021). For instance, Marasović et al. (2025) found forwards in elite U-19 football matches had lower passing accuracy (75%) but higher dribbling attempts, reflecting their risk-taking role in offensive areas. Similarly, full-backs and midfielders were noted for greater progressive passes (5.04 and 3.33 per 90 minutes, respectively), which are pivotal for advancing play (Arjol-Serrano et al., 2021). These findings highlight the importance of positional specificity in evaluating APIs, yet their applicability to international youth tournaments, where tactical systems and opponent quality vary widely, is limited (Avila-Cano et al., 2023; Bács et al., 2025). Competitive balance, defined as the relative equality of team performance within a league or tournament can influence APIs by modifying tactical approaches, with stronger teams potentially dominating possession and weaker teams relying on counterattacks (Teixeira et al., 2022). Match dynamics further complicate the examination of APIs. Studies indicate that situational variables, such as team and opponent strength, competition phase, and match location, significantly affect technical performance (Liu et al., 2015; Akyildiz et al., 2022). For example, teams facing stronger opponents may prioritize defensive stability over attacking output, lowering APIs like accurate crosses or successful dribbles (Low et al., 2022). In youth tournaments, where tactical maturity is still developing, these dynamics are amplified, as players adapt to varying playing styles and high-pressure situations. However, studies on senior international tournaments, such as the 2018 and 2022 FIFA World Cups, have identified goal-scoring patterns and technical-tactical indicators (Degrenne & Carling, 2024; Iván-Baragaño et al., 2024), but comparable analyses for youth tournaments are limited. Branquinho et al. (2025) explored offensive indicators in the 2023 FIFA Women's World Cup, finding correlations between successful dribbles and match running performance. However, no parallel studies exist for male youth international competitions.

Moreover, while technical performance has advanced in youth football, with increased passing accuracy over time (Zhou et al., 2020; Subak, 2022), the specific contribution of APIs to match success in international youth competitions remains unclear. Research by Bortnik et al. (2024) suggests that attacking actions, such as progressive passes, are critical during transitional play. However, their impact varies across match contexts (e.g., group stage vs. knockout rounds). The FIFA U-20 World Cup, with its diverse tactical approaches and condensed format, offers a unique setting to investigate these relationships. However, no studies have systematically analyzed APIs across its 2019 and 2023 editions. Furthermore, the ecological dynamics framework indicates that performance emerges from the interaction of individual, environmental, and task constraints (Davids et al., 2013), emphasizing the need to study APIs within the dynamic environment of match play. The current state of knowledge reveals several gaps. First, there is a scarcity of research on APIs in international youth tournaments, notably the FIFA U-20 World Cup, limiting understanding how these indicators drive performance in elite settings. Second, while positional differences in APIs have been documented, their interaction with match dynamics, such as possession patterns or opponent tactics, is underexamined. Third, the evolution of attacking play in youth football requires updated analyses to reflect current trends. This study aims to fill these gaps by investigating the relationship between selected APIs (e.g., accurate passes, progressive passes, successful dribbles, and accurate long balls) and match dynamics in the FIFA U-20 World Cups of 2019 and 2023, providing insights for coaches, analysts, and talent scouts in enhancing youth football performance.

Material & methods

Experimental approach to the problem

The research approach employed centers on video notational analysis, a method characterized by the thorough examination and interpretation of match highlights, to extract detailed insights. The study utilizes match highlights obtained from reputable platforms, specifically the FIFA YouTube channel (<https://www.youtube.com/channel/UCpcTrCXblq78GZrTUTLWeBw>) and FIFA+ (<https://www.plus.fifa.com/en/?gl=my>). To maintain a focused scope, the study concentrates on a sample of 104 match highlights from the 2019 and 2023 Youth World Cup editions.

Participants

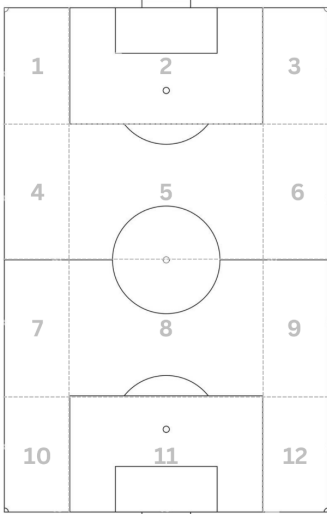
The sample included 307 goals scored across 104 matches in the 2019 and 2023 tournaments, involving 24 teams per edition, organized into four seeding pots of six teams each, based on pre-tournament ranking.

Procedures

Independent variables

Seven performance indicators were analyzed (see Table 1), including area of goals, passing sequences, goal timing, scorer and assist provider positions, goal-scoring mechanisms, and types of play.

Table 1. Independent variable descriptions

Variables	Description
Area of Goals Scored	Inside or Outside Penalty Box
Mechanism of Goals Scored	Right Leg, Left Leg, Header or Others
Passing Sequence	Short Consecutive Passes (<2 passes), Moderate Consecutive Passes (3-4 passes) or Long Consecutive Passes (>4 passes)
Position of the Scorer	Position of the goal scorer on the pitch. 
Position of the Assist Provider	Position of the player making the assist on the pitch. 
Time of Goals Scored (minutes)	0-15, 16-30, 31-45+, 46-60, 61-75 or 76-90+, 1st Half E.T, 2nd Half E. T
Type of Play	Open Play or Set Play

Dependent variables

Table 2 presents variables that were used as match dynamics for this study. “Team Rankings” were organized according to their respective seeding pots. In total, 24 teams that participated in each edition were divided into four pots of six based on a performance ranking system before being drawn into six groups of four.

Table 2. Dependent variables description

Variables	Description
Match Outcome	Win, Draw or Lose
Team Ranking	Pot 1,2,3 or 4

Statistical analysis

The data were presented as mean values with their $\pm$ standard deviations. For statistical analysis, the Shapiro-Wilk test was used to assess the normality of the data. The Independent t-test and Pearson Chi-Square test were utilised to examine the associations between variables and evaluate their significance and effect size. A significance level of $p \leq 0.05$ was set to determine the presence of correlations. The data were analysed using IBM SPSS version 25.0.

Results

Figures 1 and 2 display the frequency of goals scored based on the location of goals. They emphasize the dominance of goals scored inside the penalty box, supporting the idea that this area is the most effective zone for scoring. However, they also reveal an increase in goals scored outside the penalty box, especially in the 2023 tournament, indicating tactical variety. Meanwhile, Figure 3 shows the frequency of passing sequences leading to goals. Short and long passing sequences are apparent, with long consecutive passes being more frequent. This pattern highlights the adaptability of passing strategies in creating goal-scoring opportunities, remaining consistent across both tournaments.

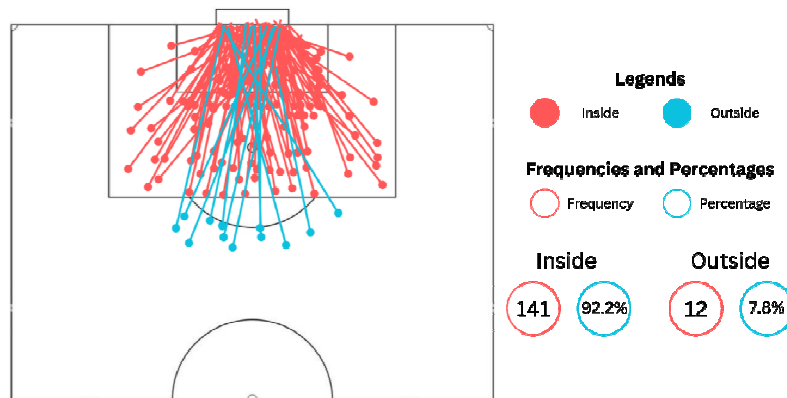


Figure 1. Scattered diagram of area of goals in 2019

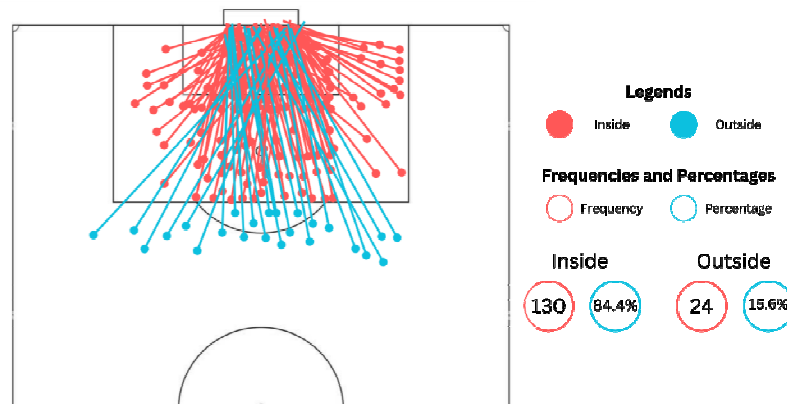


Figure 2. Scattered diagram of area of goals in 2023

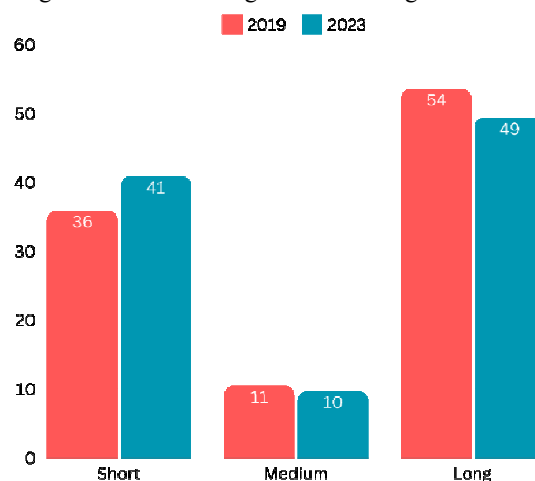


Figure 3. Percentage of passing sequence that leads towards goal scoring

Figure 4 illustrates the timing of goals; this figure shows a peak in goals scored during the "76-90+" minute interval. This pattern suggests the influence of late-game factors, such as fatigue, substitutions, and tactical adjustments, which often result in higher-scoring opportunities in the final stages of matches (Kubayi, 2020). Figure 5 and Figure 6 highlight the frequency of goals scored by players in specific positions. While positions 2 and 5 remain dominant scoring positions, the 2023 data show increased contributions from position 12, indicating a shift or expansion in offensive strategies.

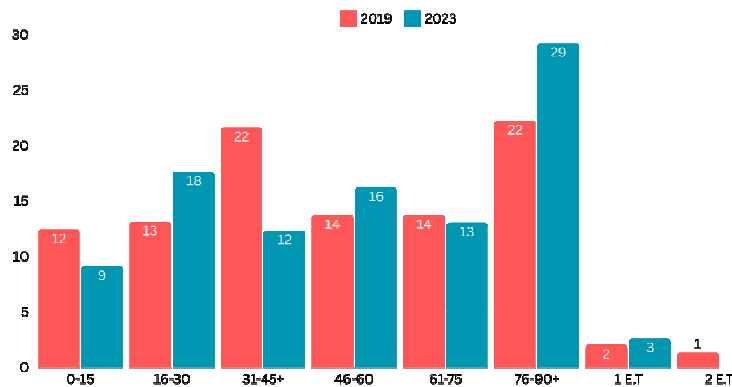


Figure 4. Percentage of goals scored according to the time (15-minute interval)

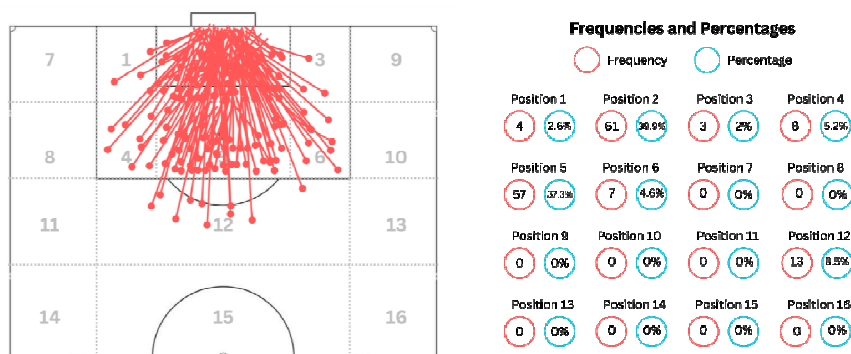


Figure 5. Scattered diagram for position of scorer in 2019

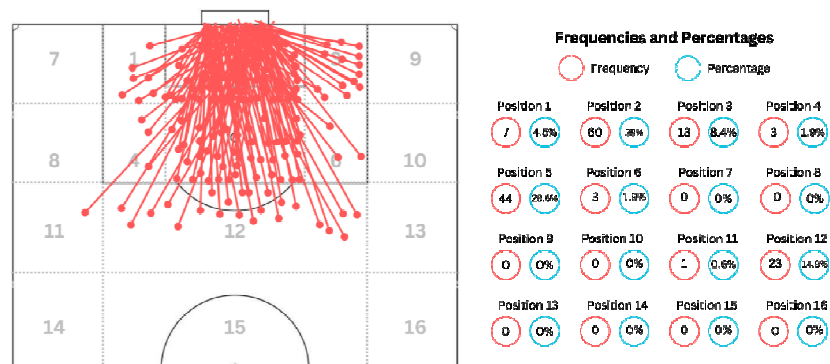


Figure 6. Scattered diagram for position of scorer in 2023

Figures 7 and 8 display the frequency of assists provided by players in different positions. In 2023, position 5 became a key assist provider, surpassing position 2, which was more prominent in 2019. This change reflects modifications in assist patterns and tactical roles in goal creation. Figure 9 illustrates the mechanism of goal scoring, indicating dominance of right-leg finishes across both tournaments. However, the rise in headed goals in 2023 (24%), compared to 13% in 2019, suggests an increased focus on aerial play and crossing strategies during that tournament. Finally, Figure 10 shows the types of play leading to goals. Open play remains the primary type across both tournaments, highlighting its important role in goal scoring. Nevertheless, set pieces and other structured plays also contribute notably, reflecting a balanced tactical approach in youth football.

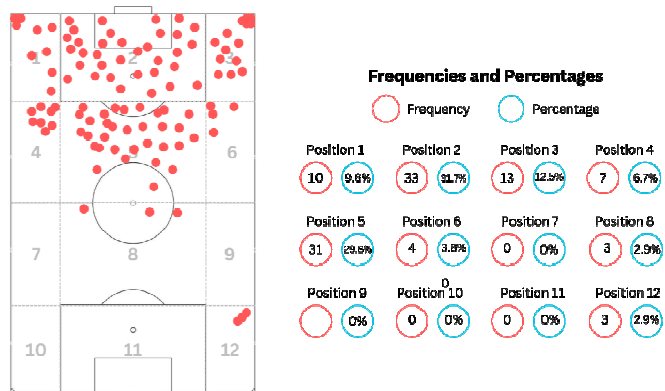


Figure 7. Scattered diagram for position of assist provider in 2019

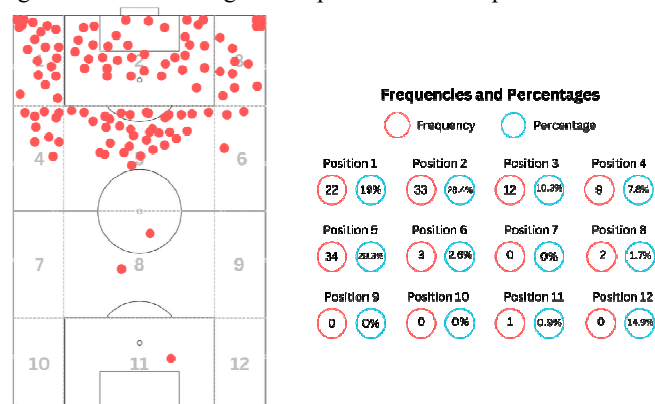


Figure 8. Scattered diagram for position of assist provider in 2023

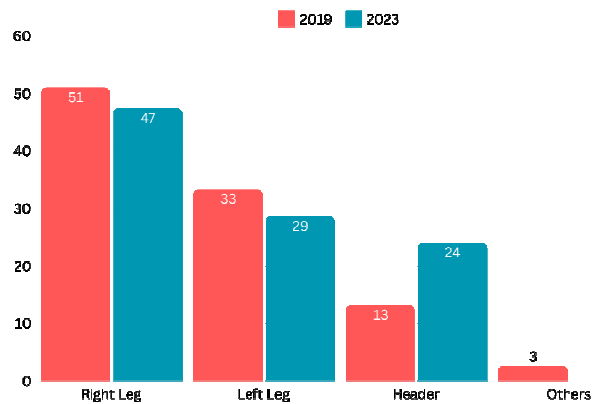


Figure 9. Percentage of goals scored according to mechanism of goal scoring

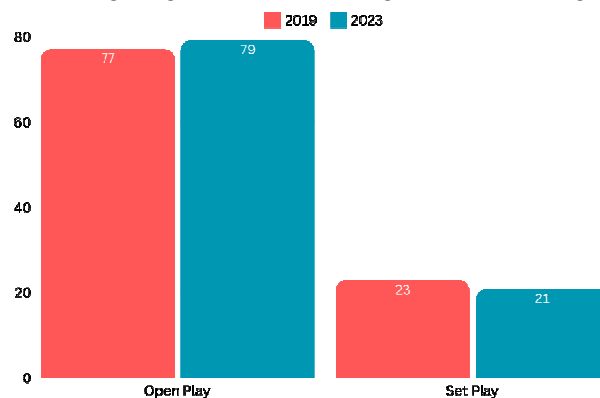


Figure 10. Percentage of goals scored according to type of play

Table 1. Mann-Whitney U test table for selected performance indicators

	Mann-Whitney U	Wilcoxon W	Z	Asymp Sig. (2-tailed)
Area of Goal	10869.000	22650.000	-2.104	0.035
Passing Sequence	11092.000	23027.000	-.980	0.327
Time of Goals Scored	10864.500	22645.500	-1.198	0.231
Position of Scorer	11681.500	23616.500	-.135	0.893
Position of Assister	11338.500	23273.500	-.581	0.561
Mechanism of Goals Scored	11417.000	23198.000	-.508	0.612
Type of Play	11459.000	23394.000	-.575	0.565

Table 1 presents the independent t-test analysis for selected performance indicators comparing the 2019 and 2023 FIFA U-20 World Cups. A significant difference was found in the category of goals scored ($p = 0.035$), indicating more goals were scored outside the penalty box in 2023. Other indicators, such as passing sequences ($p = 0.327$), timing of goals ($p = 0.327$), and mechanisms of goal scoring ($p = 0.612$), showed no significant differences between the tournaments.

Table 2. Pearson Chi-Square table for correlation between selected performance indicators and match outcome

	Year	Value	df	p
Area of Goal	2019	2.241	2	0.326
	2023	4.371	2	0.112
Passing Sequence	2019	0.642	6	0.996
	2023	0.771	4	0.942
Time of Goals Scored	2019	27.757	14	0.015*
	2023	9.444	12	0.665
Position of Scorer	2019	18.776	12	0.94
	2023	8.575	14	0.857
Position of Assister	2019	17.702	16	0.342
	2023	15.321	16	0.501
Mechanism of Goals Scored	2019	5.01	6	0.543
	2023	10.65	4	0.031*
Type of Play	2019	2.291	4	0.682
	2023	2.948	4	0.566

* $p < 0.05$

Table 2 presents the Pearson Chi-square test results for the association between performance indicators and match outcomes. The timing of goals in 2019 ($p = 0.015$) and the mechanism of goal scoring in 2023 ($p = 0.031$) showed significant associations with match outcomes. Other indicators, such as the area of goals, passing sequences, and type of play, demonstrated no significant correlations in either year.

Table 3. Pearson Chi-Square table for correlation between selected performance indicators and team ranking

	Year	Value	df	p
Area of Goal	2019	2.434	3	0.487
	2023	2.126	3	0.547
Passing Sequence	2019	11.16	9	0.265
	2023	0.3616	6	0.729
Time of Goals Scored	2019	20.161	21	0.511
	2023	21.441	18	0.258
Position of Scorer	2019	24.238	18	0.147
	2023	23.026	21	0.343
Position of Assister	2019	29.998	24	0.185
	2023	31.469	24	0.141
Mechanism of Goals Scored	2019	7.074	9	0.629
	2023	8.055	6	0.234
Type of Play	2019	5.155	6	0.524
	2023	2.246	6	0.896

Table 3 summarises the Pearson Chi-square test results for the relationship between performance indicators and team rankings. No significant associations were observed for any indicator, including the area of goals ($p = 0.487$ in 2019; $p = 0.547$ in 2023) and passing sequences ($p = 0.265$ in 2019; $p = 0.729$ in 2023), indicating the limited influence of these factors on team rankings.

Discussion

This study examined the relationship between selected attacking performance indicators, goal locations, passing sequences, timing of goals, scorer and assist provider positions, goal-scoring mechanisms, types of play, and match dynamics (outcomes and team rankings) across the 2019 and 2023 FIFA U-20 World Cups. The significant rise in goals scored outside the penalty area in 2023 ($p = 0.035$) suggests a tactical evolution, potentially reflecting adaptations to improved defensive structures or a strategic emphasis on long-range shooting accuracy. This finding aligns with Eusebio et al.'s (2025) observation of an increasing reliance on direct transition goals in contemporary football, where teams exploit space beyond traditional scoring zones to bypass compact defences. The increase in Position 12 (edge outside the penalty area) from 8.5% to 14.9% may indicate enhanced technical skills among youth players, such as shooting precision under pressure, or a response to goalkeeping improvements that reduce effectiveness within the penalty area (Kubayi, 2020).

The stability in passing sequences, with long sequences slightly predominant, supports the concept of tactical flexibility in youth football, consistent with Miswan M. S. et al.'s (2018) and Iván-Baragaño, I., et al.'s (2024) findings on balanced passing strategies in elite competitions. However, the decrease in long-passing sequences may reflect a shift toward direct play, possibly driven by the physical maturation of U-20 players, who demonstrate increased speed and decision-making under pressure (Goes et al., 2021). This shift can be framed within the constraints-led approach, where environmental and task constraints (e.g., opponent pressure, pitch size) shape attacking behaviours (Iván-Baragaño, I., et al., 2024; Davids et al., 2013). The findings also align with Branquinho et al. (2025), who identified correlations between offensive indicators and physical performance in the 2023 FIFA Women's World Cup, suggesting physical demands influence tactical choices in youth contexts. Future research could apply dynamical systems theory to quantify how these constraints affect passing patterns, providing a mechanistic understanding of tactical adaptations.

The peak in goal-scoring during the 76th–90th-minute interval, confirmed across both tournaments, corresponds with fatigue-related declines in defensive performance, as noted by Silva, D. C. D et al. (2023). This temporal pattern may be intensified in youth football by the physiological limits of U-20 players, who display lower aerobic capacity than senior athletes (Kelly, S. J., et al., 2017). This trend has implications for coaching, highlighting the importance of conditioning programs that improve endurance to maintain defensive stability late in matches. The significant correlation between goal timing and match outcomes in 2019 suggests that late goals often influence results, a phenomenon connected to psychological momentum (Jekauc, D et al., 2025). In 2023, the relationship between goal-scoring mechanisms and outcomes, especially headed goals, suggests that aerial dominance may offer a competitive advantage, particularly against less experienced defenders (Marasović et al., 2025). The increased reliance on headed goals in 2023 (23.4% vs. 15.0% in 2019) further indicates a strategic shift toward aerial play, possibly due to improved crossing accuracy or defensive weaknesses to high balls. This contrasts with senior-level trends, where foot-based finishes dominate (Çobanoğlu, 2019), highlighting a developmental difference in which youth teams may prioritize physical attributes (e.g., height, jumping ability) over technical skill. Comparisons with senior-level tournaments provide additional context. Iván-Baragaño et al. (2024) and Degrenne and Carling (2024) identified technical-tactical trends in the 2022 FIFA World Cup, such as increased use of set pieces, partially aligning with the rise in headed goals observed here. However, the youth-specific pattern of peripheral goal-scoring diverges from senior trends, emphasizing developmental differences in tactical priorities. Teixeira et al. (2022) stressed integrating physical and tactical factors using positional data, recommending that future analyses of U-20 tournaments include tracking data to capture spatial dynamics.

The lack of consistent correlations between APIs and team rankings highlights the multifactorial nature of success in youth tournaments. Weak negative correlations for goal area and passing sequences correspond with McCarthy et al. (2020), who contend that high-ranking teams adapt broadly rather than depend on specific attacking styles. This challenges the predictive capacity of notational analysis in youth football, as situational factors (e.g., referee decisions, team cohesion) and psychological elements (e.g., resilience) may outweigh technical indicators. As explored by Avila-Cano et al. (2023) and Bács et al. (2025), competitive balance may also reduce the impact of APIs, since evenly matched teams in the FIFA U-20 World Cup use varied tactical approaches.

Pearson's chi-squared analyses revealed context-specific relationships between performance indicators and match outcomes. The significant correlation of goal timing in 2019 ($p = 0.015$) likely reflects situational factors, such as crucial late goals determining results, linked to psychological momentum in competitive contexts (Jekauc, D et al., 2025). The 2023 association with goal-scoring mechanism ($p = 0.031$), particularly the increase in headed goals, suggests aerial strength may confer a competitive advantage, potentially because less experienced defenders struggle with aerial duels. However, the lack of consistent correlations across tournaments underscores the multifactorial nature of match success, where attacking indicators interact with defensive resilience, goalkeeper performance, and team cohesion factors not captured in this analysis.

Several limitations restrict these findings. Reliance on video highlights introduces potential bias, as missed events (e.g., offside decisions, defensive actions) may skew interpretations. The exclusion of defensive and goalkeeper data limits the comprehensive assessment of match dynamics, a gap noted in prior studies (Goes

et al., 2021). Additionally, the sample's focus on U-20 tournaments may not generalize to senior or other youth age groups, where physical and tactical profiles differ. Future research should incorporate real-time tracking data and qualitative interviews with coaches to capture defensive contributions and contextual nuances. Advanced statistical models, such as multilevel regression or network analysis, could elucidate the interaction between attacking and defensive indicators, improving predictive accuracy.

These findings expand the literature by identifying youth-specific patterns, such as increased peripheral and aerial goal-scoring, which contrast with senior-level trends. The implications are important for coaching, suggesting a need for targeted training in long-range shooting and aerial duels, alongside strategies to exploit late-game opportunities. For talent identification, scouts should prioritize players excelling in emerging zones (e.g., Position 12) and aerial contests, aligning with the developmental demands of youth football.

Conclusion

This study on attacking performance indicators (APIs) area of goals, passing sequences, goal timing, scorer/assist positions, scoring mechanisms, and play types in the FIFA U-20 World Cups of 2019 and 2023 reveals tactical changes with significant implications for youth football. The rise in goals from outside the penalty area (14.9% in 2023 vs. 8.5% in 2019) and headed goals (23.4% vs. 15.0%) highlights evolving strategies, while late-game scoring peaks (76th–90th minute) underscore fatigue-related chances. These findings are highly relevant for football academies, clubs, and federations seeking to optimize performance and talent development. The increase in goals outside the penalty box suggests training should prioritize long-range shooting and crossing accuracy to counter tight defences. The rise in headed goals emphasizes aerial duel skill, essential for youth players exploiting physical attributes. Clubs can improve competitive edge by focusing on these skills, enhancing match outcomes and player marketability. The lack of consistent API-ranking correlations reflects the influence of competitive balance and player-environment interactions. Clubs adopting holistic analysis, incorporating psychological and situational elements, can enhance team selection and development. The ecological dynamics framework supports cultivating adaptive players for varied match contexts. In conclusion, these findings enable clubs to align training and scouting with youth football's evolving requirements, long-range goal scoring, aerial skill, and late-game endurance. This strengthens competitive performance and talent pathways, driving sporting success. Advanced analytics and interdisciplinary methods will further reveal these insights, promoting innovation in the football industry.

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