Journal of Computers Vol. 37 No. 4, August 2026, pp. 103-118
https://doi.org/10.63367/19911599202608370400 7

Integration of Intuitionistic Fuzzy Sets and Multicriteria Decision-Making for Football Talent Selection

Qi-Xing Huang[1,2], Wu-Shiun Tao[3], Hong-Bin Chang[2], and Ching-Tang Wang[4*]

[1] Department of Sport Performance, National Taiwan University of Sport, Taichung, Taiwan
qxhuang@zjff.edu.cn

[2] Zhejiang Fashion Institute of Technology, NingBo, China
a0922920955@gmail.com

[3] Department of Ball Sport, National Taiwan University of Sport, Taichung, Taiwan
412812816@qq.com

[4] Department of Sport Information and Communication, National Taiwan University of Sport, Taichung, Taiwan
tang@ntus.edu.tw

Received 4 November 2025; Revised 13 January 2026; Accepted 15 January 2026

Abstract. In this study, we aimed to develop a position-oriented evaluation model for football talent selection by applying the Intuitionistic Fuzzy Vlsekriterijumska Optimizacija Kompromisno Resenje method to analyze and rank ability indicators for three on-field positions: forwards, midfielders, and defenders. Based on an extensive literature review, 19 ability indicators were identified across five primary dimensions: technical, tactical, physical, psychological, and social. A total of 53 football coaches with practical experience and official coaching licenses participated in the evaluation. The results revealed significant positional differences in the prioritization of ability indicators. Forwards placed the greatest emphasis on shooting, midfielders on passing and ball reception, and defenders on one-on-one defensive ability. Furthermore, several competencies—namely autonomous decision-making, spatial awareness and positioning, tactical execution, and responsiveness to ball movement—emerged as core capabilities shared across all positions. These findings support the scientific and systematic development of football talent selection frameworks and provide practical guidance for coaches in designing training strategies and long-term player development plans.

Keywords: football talent selection, field position analysis, multicriteria decision-making, intuitionistic fuzzy set

1 Introduction

As one of the most popular sports worldwide, football offers not only high levels of entertainment and competitiveness but also serves as an important platform for showcasing a nation's soft power and cultural values. According to FIFA [1], the final match of the 2022 Qatar World Cup attracted nearly 1.5 billion viewers, with a cumulative audience exceeding 5 billion, highlighting football's dominant position in the global sports industry. For decades, European and South American countries have maintained leadership in world football, demonstrating highly mature and professional development in areas such as professional league management, youth training systems, and sports science applications [2]. Among these, the "Big Five Leagues"—the Premier League, La Liga, Bundesliga, Serie A, and Ligue 1—continue to attract top-tier players and coaches globally and to innovate in tactical concepts, training methods, and business models (Analytics Cao [3]; Yi et al. [4]), further strengthening their leading positions in international football. In contrast, football development in Taiwan has progressed relatively slowly compared with the highly professionalized European leagues and the well-established youth training systems in Asian football powerhouses such as Japan and South Korea. The government launched a 6-year football development plan in 2018, covering infrastructure improvement, school participation, and corporate support; however, the overall implementation rate reached only 47.22% [5], indicating persistent structural challenges in interdepartmental coordination and long-term planning. Regarding

* Corresponding Author

talent selection systems, current practices rely largely on coaches' subjective experience and observational judgment, with limited use of quantitative and systematic tools for talent identification. This reliance may lead to missed opportunities for potential players or inaccurate selection and training decisions [6].

With the increasing scientific rigor of competitive sports, modern football talent selection decisions increasingly emphasize multidimensional integration and data-driven approaches. Players are assigned different roles and responsibilities based on their on-field positions. For example, forwards must possess strong finishing ability and movement judgment; midfielders require the capacity to transition between attack and defense and to control match rhythm; and defenders should demonstrate defensive confrontation skills and spatial perception [7, 8]. Player performance is influenced by multiple factors, including technical skills, physical attributes, tactical understanding, and psychological and social aspects, which makes comprehensive assessment through a single dimension difficult. Therefore, talent selection assessment has become a complex multicriteria decision-making problem.

In this context, we aimed to adopt an integrated model that combines Intuitionistic Fuzzy Set (IFS) theory with the Vlsekriterijumska Optimizacija I Kompromisno Resenje **(**VIKOR) multicriteria decision-making method to construct a talent selection index ranking system applicable to different positions, including forwards, midfielders, and defenders. This approach addresses the ambiguity and hesitation commonly present in expert evaluations and ranks talent selection indicators based on aggregated group opinions, thereby revealing positional differences in emphasized abilities. We aim to establish a systematic, evidence-based talent selection system with practical applicability.

2 Literature Review

With the rapid development of sports science and data technology, contemporary talent selection decisions in sports have shifted from traditional experience- and observation-based models to more systematic procedures that emphasize multidimensional integration, scientific approaches, and data-driven decision-making [9].

2.1 Theories and Challenges in Talent Identification in Sports

Talent identification (TID) focuses on recognizing athletes' potential at an early stage and nurturing them to reach their peak performance [10]. Research indicates that TID involves multiple dimensions, including technical skills, physiological conditions, psychological traits, and sociocultural environments [11]. However, early talent identification is often influenced by short-term performance, coaches' subjective preferences, and athletes' maturation processes, which can lead to the premature exclusion of potentially promising players [12].

In football, Sarmento et al. [13] noted that talent selection outcomes are significantly influenced by the relative age effect and sociocultural factors. Their findings showed that successful players tend to demonstrate advantages across multiple dimensions, including technical ability, tactical understanding, physical fitness, and psychological resilience. However, these characteristics can vary according to age, maturity level, and playing position, emphasizing the need for time-sensitive and individualized talent selection strategies. In recent years, artificial intelligence (AI) and big data analytics have become increasingly integrated into talent identification practices. Technologies such as visual tracking systems, AI-based performance analysis models, and predictive tools are now widely used in professional teams and youth development programs. These tools help reduce subjective bias, improve the accuracy of talent detection, and enhance overall system efficiency [14–16].

2.2 Diverse Indicators and Position-Specific Demands in Football Talent Identification

Football is a high-intensity, tactically complex, and physically demanding team sport in which player performance is influenced not only by individual abilities but also by on-field roles and responsibilities [17]. Therefore, talent identification assessments must account for functional differences among positions and establish corresponding indicators based on the specific tasks associated with each role [18]. Slimani and Nikolaidis [19] reported that forwards require explosive power and shooting accuracy, midfielders must balance aerobic endurance with ball control and rhythm management, and defenders emphasize physical confrontation and spatial awareness. Similarly, Bortnik et al. [20] and Villaseca-Vicuña et al. [21] emphasized that each on-field position entails distinct tactical roles and that the corresponding physical attributes and skill requirements should

be distinguishable. Regarding evaluation criteria, recent literature generally categorizes talent selection indicators into five dimensions: technical skills, tactical understanding, physical condition, psychological traits, and social abilities [22–24]. Based on these theoretical foundations, we identify 19 key ability indicators applicable to three main positions—forward, midfielder, and defender—which form the basis for constructing the ranking model and subsequent analytical evaluation.

Technical Skills. Technical ability is a core criterion for identifying potential players [25]. According to the literature review, the technical dimension comprises six key evaluation indicators. First, bilateral ability refers to a player's flexibility and balance in using both feet. Players with well-developed dual-foot skills can expand their decision-making options under high-pressure situations [26–28]. Second, one-on-one attacking ability reflects a player's technical capacity to break through defensive pressure in tight spaces and create scoring opportunities. This indicator is particularly important for evaluating attacking players [29–31]. In contrast, one-on-one defending ability is a critical indicator for defensive players, as strong individual defending skills contribute to overall defensive stability [32–34]. Passing and receiving ability is a fundamental technical skill for tactical execution. Passing accuracy and receiving stability directly influence the efficiency of ball distribution and rhythm control [35–38]. Dribbling ability relates to a player's technical control and finesse under pressure and represents an essential foundational skill, particularly for midfielders and defenders [3, 39, 40]. Finally, shooting ability directly affects the team's goal-scoring efficiency. It requires a combination of power, accuracy, and timing judgment, making it a critical component in assessing a player's offensive potential [35, 41, 42].

Tactical Skills. Tactical literacy is a key ability that distinguishes elite players from foundational players and primarily involves a player's perception of and response to spatial, temporal, and opponent-related dynamics during a match [43, 44]. Compared with purely technical skills, tactical performance emphasizes a player's ability to make real-time decisions and apply strategic responses in dynamic situations, which significantly influences overall team performance [45]. First, spatial awareness and movement sense assess a player's ability to interpret field space accurately and position themselves in tactically meaningful areas at appropriate moments, thereby creating offensive or defensive advantages [46–48]. Second, autonomous decision-making refers to a player's capacity to select the most appropriate tactical action within a split second, particularly under high-pressure conditions [49–51]. Third, tactical execution ability evaluates whether a player can effectively implement coaching instructions and team strategies, which is crucial for the coordinated functioning of attacking and defending systems [43, 47, 51]. In summary, while tactical skills are difficult to quantify, they represent a core competency in modern football, particularly for midfielders and defenders, whose on-field value is often reflected in tactical performance and in-game execution.

Physical Attributes. As a high-intensity, intermittent, and physically demanding sport, football has long relied on physical fitness as a key dimension for evaluating player potential [52]. Physical capabilities influence not only individual technical performance but also the functional roles associated with different playing positions and therefore serve as an important criterion for early talent identification. Based on existing research, the physical dimension includes four key ability indicators.

First, coordination is a prerequisite for executing complex technical actions. Strong body coordination helps players maintain stability and fluidity in high-speed or dynamic situations [53–55].

Second, agility refers to a player's ability to rapidly change direction, stop, and restart, thereby enhancing spatial adaptability during transitions between attack and defense [14, 56, 57].

Third, acceleration speed reflects a player's ability to initiate movement and increase speed quickly over short distances. This ability is critical for attackers to create space, evade defenders, and complete key movements [58–60].

Finally, reaction speed and adaptability to change assess a player's ability to process visual information and adjust physically in response to sudden situations. This skill holds significant practical value, particularly in high-pressure defensive scenarios and rapid transitions between attack and defense [57, 61, 62].

Psychological Traits. In high-pressure and dynamic competitive environments, an athlete's psychological characteristics are critical factors influencing training performance stability, on-field resilience, and long-term development potential. Traditional talent selection systems have focused largely on physiological and technical assessments; however, recent studies increasingly emphasize that psychological traits—such as mental resilience,

intrinsic motivation, and emotional regulation—play a key role in predicting athletic performance and should be integrated into evaluation frameworks [63, 64]. Based on relevant literature, we identify three core psychological traits closely related to football match scenarios.

Determination (ambition and perseverance) refers to a player's ability to display strong will, continuous effort, and persistence when facing challenges. Players with high determination can maintain positive performance and a winning mindset in adverse situations, such as trailing in score or experiencing physical exhaustion [65–67]. Commitment (relentless work rate) reflects sustained engagement and proactive behavior during matches, including pressing, defensive coverage, and support for teammates. Even near physical limits, committed players can maintain high involvement and help sustain team rhythm [68–70].

Courage refers to a player's ability to execute decisive technical and tactical actions under pressure, take risks, and assume responsibility for critical moments, demonstrating high confidence and stress tolerance [71–73].

In summary, the psychological dimension not only reflects personality and intrinsic motivation but also directly influences training stability, match execution consistency, and long-term potential. It should therefore be regarded as an essential criterion in talent selection systems, particularly for identifying elite athletes and assessing long-term development prospects.

Social Skills. According to the "Four Development Dimensions" model proposed by the English Football Association, social skills are considered as important as technical, psychological, and physical abilities and serve as a key factor in supporting overall player development and team performance (England Football Learning, 2020). Based on the relevant literature, we categorize the social dimension into three main ability indicators.

First, learning and comprehension assess a player's ability to understand coaching tactical instructions rapidly and translate them effectively into on-field performance. This ability influences training uptake and adaptation to match rhythm, particularly in teams with diverse tactical systems and frequent player rotation. Players with strong learning capacity can adjust to changing match rhythms within a short time frame, thereby enhancing individual performance [74–76].

Second, communication skills refer to a player's ability to accurately convey tactical information, coordinate actions, and adjust formations during matches. Effective communicators can relay tactical messages precisely, provide timely feedback, and support formation adjustments, which improves the efficiency of tactical execution [77–79].

Finally, team spirit reflects a player's alignment with team goals and cooperative attitude. Players with strong team spirit tend to maintain stable performance and encourage teammates under pressure, fostering positive interactions that support on-field psychological resilience and collective effectiveness [80–82].

In summary, while social skills are difficult to quantify directly, they play an essential and often overlooked role in enhancing tactical coordination and team efficiency in practical talent selection. For professional teams with complex tactical systems, evaluating these skills has gained increasing recognition.

Based on the above literature review, modern football talent identification should be grounded in a multidimensional theoretical framework encompassing technical, tactical, physical, psychological, and social aspects to assess player potential and development prospects comprehensively. However, current practices often rely on single dimensions or fragmented indicators, which fail to account fully for the functional characteristics and specific ability requirements of different on-field positions. Existing research indicates that positional roles place varying emphasis on each ability dimension [21], highlighting the need for a position-specific (position specificity) talent selection mechanism that can flexibly adjust the weighting of ability dimensions based on on-field roles [83]. Therefore, developing a scientifically based talent assessment framework that integrates multidimensional indicators, adapts to positional demands, and allows adjustable ranking mechanisms may enhance the logical consistency of selection decisions and the effectiveness of long-term development strategies, while providing empirical support for the institutionalization and professionalization of football talent selection systems.

3 Methods

3.1 Research Framework

This is a study focused on the three main football positions—forward, midfielder, and defender—and conducts

a ranking analysis of talent selection indicators based on the specific ability requirements of each position. Drawing on the preceding literature review, five key dimensions influencing football talent evaluation were identified: technical skills, tactical understanding, physical attributes, psychological traits, and social abilities. These dimensions were further refined into 19 representative talent selection indicators, which form the basis of the analysis.

To address uncertainties often encountered in practical talent selection, such as semantic ambiguity, subjective hesitation, and conflicts among criteria, we employ the Intuitionistic Fuzzy VIKOR (IF-VIKOR) method as a multicriteria decision-making tool. This approach mitigates intuitive bias and fuzzy uncertainty in semantic scoring while integrating group judgments to clarify the relative importance of each ability indicator. Using this method, we established a structured, position-sensitive, and practically applicable talent evaluation framework.

The overall research process is illustrated in Fig. 1 and includes indicator construction, semantic transformation, fuzzy decision matrix development, defuzzification, and IF-VIKOR ranking analysis. Ultimately, our analysis yields ranked ability indicators for the three on-field positions, providing a reference for decision-making in football talent selection systems and player development strategies.

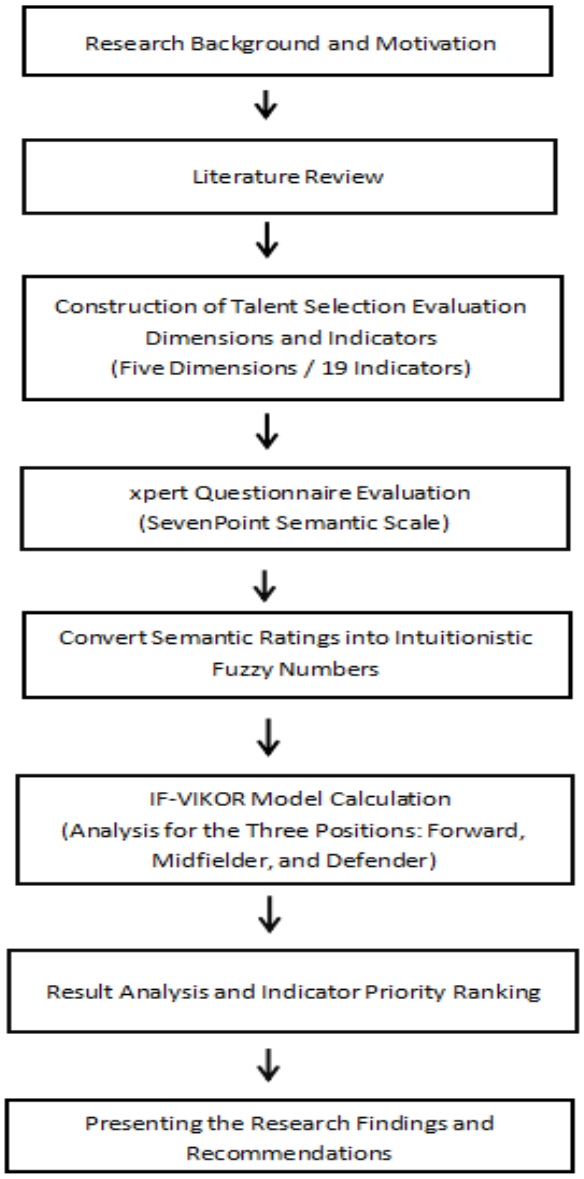

Fig. 1. Research framework

3.2 Rationale for Method Selection

Traditional sports talent selection assessments often rely on coaches' experience and subjective observation, with limited systematic integration of multiple criteria. With advances in multicriteria decision-making (MCDM) theory and data processing technologies, an increasing number of studies have applied MCDM methods to sports talent identification and performance evaluation to address subjectivity and incomplete information in expert opinions [84, 85].

Among commonly used MCDM approaches, the VIKOR method is particularly suitable for ranking problems in which criteria conflict and the performance of evaluation objects varies significantly. The method is based on a compromise logic that seeks to maximize group utility while minimizing individual regret [86]. To further address ambiguity and hesitation in expert evaluations, scholars have integrated IFS theory with the VIKOR method, resulting in the IF-VIKOR model. This enhances the method's ability to handle fuzzy semantics and uncertainty in collective assessments [87].

The IF-VIKOR method retains the stability and compromise advantages of the VIKOR approach while enabling the processing of fuzzy numerical values and hesitation degrees from multiple experts' subjective judgments. It has been widely applied to decision-making problems in fields such as education, energy, manufacturing, and technology [88, 89], as well as in sports-related contexts, including talent selection [90, 91], demonstrating strong cross-domain feasibility and stability.

In summary, we adopted the IF-VIKOR method as the primary analytical approach because of its suitability for multicriteria fuzzy ranking problems and its ability to accommodate positional differences in the relative importance of talent selection indicators. This approach effectively supports the study's objective of ranking indicators for position-specific football talent evaluation.

3.3 Data Collection and Expert Questionnaire Design

The questionnaire design in this study uses a seven-point semantic scale (1 = extremely unimportant, 7 = extremely important) to assess the perceived importance of each talent selection criterion across different playing positions (forward, midfielder, and defender). The questionnaire content was developed based on the 19 selection criteria identified through the literature review. A total of 53 questionnaires were distributed, all of which were fully completed and returned, yielding a 100% response rate. All respondents were experienced football coaches with varying levels of coaching experience and professional qualifications, ensuring both representativeness and methodological rigor.

To transform semantic evaluation results into computable fuzzy values, the scores were converted into triangular intuitionistic fuzzy numbers (TIFNs) according to the recommendations of Boran et al. [92]. Based on these values, an IF decision matrix was constructed. The correspondence between semantic descriptions and their associated numerical values is presented in Table 1.

Table 1. Semantic table of triangular intuitionistic fuzzy numbers

Seven-point semantic scale	Scale for expressing proximity and importance	Triangular intuitionistic fuzzy number
1	Highly unimportant	$<\left[(0.05,0.10,0.15);0.1\right],\left[(0.80,0.85,0.85);0.8\right]>$
2	Very unimportant	$<\left[(0.15,0.20,0.25);0.2\right],\left[(0.65,0.70,0.75);0.7\right]>$
3	Slightly unimportant	$<\left[(0.30,0.35,0.40);0.3\right],\left[(0.50,0.55,0.60);0.6\right]>$
4	Neutral	$<\left[(0.45,0.50,0.55);0.5\right],\left[(0.35,0.40,0.45);0.4\right]>$
5	Somewhat important	$<\left[(0.60,0.65,0.70);0.7\right],\left[(0.20,0.25,0.30);0.2\right]>$
6	Very important	$<\left[(0.75,0.80,0.85);0.8\right],\left[(0.10,0.15,0.20);0.1\right]>$
7	Extremely important	$<\left[(0.85,0.90,0.90);0.9\right],\left[(0.0,0.05,0.05);0.0\right]>$

3.4 IF-VIKOR Analysis Procedure

In this study, we follow the IF-VIKOR algorithm proposed by Du et al. (2021) and Opricovic and Tzeng [86]. The analysis is conducted in seven steps:

Step 1. Construction of the IF Decision Matrix. Experts evaluate each assessment criterion using linguistic variables, which are converted into TIFNs. Here, μ_{ij} denotes the membership degree, vij denotes the non-membership degree, and the hesitation degree is defined as $\pi_{ij} = 1 - \mu_{ij} - v_{ij}$:

$$\tilde{x}_{ij}^{(k)} = \left\langle \left(a_{ij}^{(k)}, b_{ij}^{(k)}, c_{ij}^{(k)} \right);\ \mu_{ij}^{(k)}, v_{ij}^{(k)} \right\rangle . \tag{1}$$

When multiple experts provide evaluations, the IF Weighted Averaging operator aggregates the results:

$$\tilde{x}_{ij} = \frac{1}{\lambda} \sum_{k=1}^{\lambda} \tilde{x}_{ij}^{(k)} . \tag{2}$$

Step 2. Defuzzification Process. To convert TIFNs into a single real value, the Bounded Normalized Rank method is applied to emphasize the most reliable central value and address fuzziness and uncertainty. The defuzzification formula is:

$$f_{ij} = \left(\frac{a_{ij} + 4b_{ij} + c_{ij}}{6} \right) \cdot \mu_{ij} . \tag{3}$$

Step 3. Calculation of Positive and Negative Ideal Solutions. The Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS) represent the best and worst values for each criterion, respectively. The PIS corresponds to the maximum value of benefit criteria and the minimum value of cost criteria, while the NIS represents the opposite. Let f_i^+ and f_i^- denote the PIS and NIS for the *i*th criterion:

$$f_i^+ = \max_j f_{ij} . \tag{4}$$

$$f_i^- = \min_i f_{ij} . \tag{5}$$

Step 4. Normalization. Criterion values are normalized to a range between 0 and 1, using:

$$g_{ij} = \left(f_i^+ - f_{ij} \right) / \left(f_i^+ - f_i^- \right) . \tag{6}$$

Step 5. Calculation of Overall Benefit and Individual Regret. The overall benefit (group utility) Sj and the maximum individual regret value Rj for each alternative are calculated as:

$$S_j = \sum_{i=1}^{n} w_i \left(f_i^+ - f_{ij} \right) / \left(f_i^+ - f_i^- \right) . \tag{7}$$

$$R_j = \max_i \left[w_i \left(f_i^+ - f_{ij} \right) / \left(f_i^+ - f_i^- \right) \right]. \quad (8)$$

Step 6. Calculation of the Compromise Index Q_j. The compromise index Q_j is calculated by combining the S_j and the R_j values. Let $S^+ = min_j S_j$, $S^- = max_j S_j$, $R^+ = min_j R_j$, $R^- = max_j R_j$. The preference coefficient λ is typically set to 0.5 [86], to balance group utility and individual regret:

$$Q_j = \lambda \cdot \frac{S_j - S^+}{S^- - S^+} + (1-\lambda) \cdot \frac{R_j - R^+}{R^- - R^+}. \quad (8)$$

Step 7. Ranking and Selection of the Best Alternative. Alternatives are ranked in ascending order of their Q_j values. The alternative with the smallest Q_j value is identified as the optimal solution.

4 Results

In this study, we applied the IF-VIKOR method to rank 19 selection criteria for three positions: forward, midfielder, and defender. Following the IF-VIKOR procedure, linguistic evaluations were converted into TIFNs, an IF decision matrix was constructed, and defuzzification was performed. The alternatives were then ranked based on the obtained S_j and Q_j values. Because we treated "individual evaluation objects" and "various ability criteria" as the comparison alternatives, each alternative corresponded to a single evaluation criterion. As noted by Opricovic and Tzeng [86], in this context, the S_j and Q_j values tend to be similar.

Therefore, to avoid redundancy, we selectively report the ranking results based on the S_j and Q_j values. The corresponding results are presented in Table 2– Table 4.

Table 2. IF-VIKOR analysis results for the forward position

Selection criteria	S_j	Q_j	Ranking
Two-footed ability	0.012	0.315	8
One-on-one attack ability	0.010	0.253	4
One-on-one defense ability	0.040	1.000	19
Passing and receiving skills	0.013	0.328	9
Ball control	0.017	0.427	12
Shooting ability	0.000	0.000	1
Spatial awareness and positioning sense	0.004	0.104	2
Autonomous decision-making	0.009	0.238	3
Tactical execution ability	0.017	0.442	14
Coordination	0.017	0.427	13
Agility	0.019	0.484	15
Explosive speed	0.012	0.312	7
Reaction speed and change of direction	0.012	0.304	6
Determination (Initiative, Never give up)	0.010	0.254	5
Commitment (Unyielding effort in running)	0.029	0.735	18
Bravery	0.017	0.420	11
Learning ability and understanding	0.022	0.559	16
Communication skills	0.024	0.597	17
Teamwork spirit	0.016	0.405	10

Table 3. IF-VIKOR analysis results for the midfielder position

Selection criteria	S_j	Q_j	Ranking
Two-footed ability	0.009	0.206	5
One-on-one attack ability	0.029	0.688	17
One-on-one defense ability	0.021	0.506	13
Passing and receiving skills	0.000	0.000	1
Ball control	0.004	0.095	2
Shooting ability	0.038	0.895	18
Spatial awareness and positioning sense	0.008	0.186	4
Autonomous decision-making	0.004	0.095	2
Tactical execution ability	0.010	0.245	6
Coordination	0.022	0.522	14
Agility	0.025	0.583	15
Explosive speed	0.042	1.000	19
Reaction speed and change of direction	0.015	0.364	10
Determination (Initiative, Never give up)	0.017	0.399	11
Commitment (Unyielding effort in running)	0.021	0.490	12
Bravery	0.025	0.597	16
Learning ability and understanding	0.015	0.346	9
Communication skills	0.012	0.282	7
Teamwork spirit	0.012	0.282	7

Table 4. IF-VIKOR analysis results for the defender position

Selection criteria	S_j	Q_j	Ranking
Two-footed ability	0.029	0.522	14
One-on-one attack ability	0.051	0.907	18
One-on-one defense ability	0.000	0.000	1
Passing and receiving skills	0.023	0.404	12
Ball control	0.030	0.534	16
Shooting ability	0.056	1.000	19
Spatial awareness and positioning sense	0.035	0.626	17
Autonomous decision-making	0.019	0.329	8
Tactical execution ability	0.012	0.217	5
Coordination	0.026	0.455	13
Agility	0.029	0.522	14
Explosive speed	0.022	0.390	11
Reaction speed and change of direction	0.016	0.285	6
Determination (Initiative, Never give up)	0.008	0.145	3
Commitment (Unyielding effort in running)	0.021	0.370	10
Bravery	0.011	0.202	4
Learning ability and understanding	0.020	0.356	9
Communication skills	0.017	0.300	7
Teamwork spirit	0.006	0.112	2

The results indicate clear positional differences in key abilities. For forwards, the top three criteria are “shooting,” “spatial awareness and positioning sense,” and “autonomous decision-making.” For midfielders, the top three are “passing and receiving skills,” “ball control,” and “autonomous decision-making.” For defenders,

the most emphasized criteria are "one-on-one defensive ability," "team spirit," and "determination (initiative, never give up)." In addition, "autonomous decision-making," "spatial awareness and positioning sense," "tactical execution ability," and "reaction speed and change of direction" rank highly across all three positions, indicating strong cross-positional commonality. These abilities can therefore be considered core competencies that modern football players should possess.

Table 5. Overview of IF-VIKOR ranking for selection criteria across the three positions

Ranking	Forward position criteria	Midfielder position criteria	Defender position criteria
1	Shooting ability	Passing and receiving skills	One-on-One Defensive Ability
2	Spatial awareness and positioning sense	Ball control	Teamwork spirit
3	Autonomous decision-making	Autonomous decision-making	Determination (initiative, never give up)
4	One-on-one attack ability	Spatial awareness and positioning sense	Bravery
5	Determination (Initiative, Never give up)	Two-footed ability	Tactical execution ability
6	Reaction speed and change of direction	Tactical execution ability	Reaction speed and change of direction

By summarizing the ranking results across the three positions (Table 5), the ability structure can be seen to align with the functional characteristics of each role. Forwards emphasize attacking skills and final decision-making, midfielders prioritize technical stability and game flow control, and defenders focus on defensive confrontation and mental toughness. These findings provide a basis for talent selection and offer practical guidance for setting training priorities and designing player development plans.

5 Discussion and Conclusion

In this study, we employed the IF-VIKOR method to analyze and rank 19 talent selection indicators across three major on-field football positions: forwards, midfielders, and defenders. The results demonstrate clear positional differentiation in the prioritization of key competencies. Forwards prioritized shooting, spatial awareness and off-the-ball movement, and autonomous decision-making. Midfielders emphasized passing and receiving ability, ball control, and autonomous decision-making. Defenders, in contrast, focused on one-on-one defending ability, team spirit, and determination (including competitiveness and persistence). These findings indicate that technical, tactical, and psychological abilities carry different weights across positions, suggesting the need for position-specific talent selection criteria.

In addition, four competencies—autonomous decision-making, spatial awareness and off-the-ball movement, tactical execution, and responsiveness to ball dynamics—consistently ranked among the top indicators across all three positions. These findings identify a shared set of core competencies required of modern football players. This result aligns with the trends reported in recent studies highlighting autonomous decision-making as a key contributor to adaptability and responsiveness during rapid offensive–defensive transitions [49, 93]. Spatial perception and positioning play a central role in offensive organization and spatial exploitation on the pitch [94, 95], while responsiveness to ball movement is critical for timely reaction to tactical situations and effective execution of technical actions [96, 97]. Accordingly, talent selection and training programs should incorporate these competencies into a shared core framework for systematic reinforcement.

By integrating IFS theory with the VIKOR method, we effectively address uncertainty and subjectivity in expert linguistic judgments and synthesize collective perspectives in multicriteria decision-making. The proposed framework offers a theoretically grounded and practically applicable model for sports talent selection, supporting greater scientific rigor, systematization, and transparency in evaluation procedures.

Our findings provide a reference for developing future football talent selection systems and training plans. Coaching teams and training units at various levels are encouraged to design targeted strategies based on positional priorities. For example, forwards should focus on shooting accuracy and in-game decision-making; midfielders should emphasize ball control and distribution tempo; and defenders should prioritize defensive stability and psychological resilience. In addition, the cross-positional competencies identified—autonomous

decision-making, spatial awareness and movement, tactical execution, and responsiveness to ball variation—are recommended as universal core components of training curricula to enhance player adaptability and tactical comprehension on the field.

Future research may incorporate performance metrics, physiological data, and real-match statistics to develop a predictive and empirically validated evaluation system that supports coaches in developing long-term player development strategies. Cross-validation with other multicriteria decision-making methods is also recommended to assess model applicability and robustness in practical selection contexts. Finally, expanding the indicator set may further enhance the completeness and scientific relevance of the evaluation framework, thereby providing more practical decision-making support for football talent identification.

References

[1] FIFA, FIFA World Cup Qatar 2022™ in numbers, 2022. https://publications.fifa.com/en/annual-report-2022/tournaments-and-events/fifa-world-cup-quatar-2022/fifa-world-cup-qatar-2022-in-numbers/

[2] T. Daddi, F. Rizzi, G. Pretner, N. Todaro, E. Annunziata, M. Frey, F. Iraldo, Environmental management of sport events: A focus on European professional football, Sport, Business and Management: An International Journal 12(2)(2021) 208–232.
https://doi.org/10.1108/SBM-05-2020-0046

[3] S. Cao, Passing path predicts shooting outcome in football, Scientific Reports 14(1)(2024) 9572.
https://doi.org/10.1038/s41598-024-60183-7

[4] Q. Yi, R. Groom, C. Dai, H. Liu, M.Á. Gómez Ruano, Differences in technical performance of players from "the big five" European football leagues in the UEFA Champions League, Frontiers in psychology 10(2019) 2738.
https://doi.org/10.3389/fpsyg.2019.02738

[5] M.H. Lin, Audit report: The sixyear football plan is fading—Men's national team remains at the bottom of world rankings, United Daily News (2024, August 5).

[6] J.R. Chen, C.Y. Hsieh, K.W. Luo, C.H. Yu, Y.C. Hung, Toward a sports powerhouse: Evolution and challenges of sports talent selection policies, Journal of National Sports 53(2)(2024) 28–31.

[7] R. Perrotta, A.N. Ungureanu, D. Cherubini, P.R. Brustio, C. Lupo, Technical, tactical, and time–motion match profiles of the forwards, midfielders, and defenders of a Men's football Serie A team, Sports (Basel) 13(2)(2025) 28.
https://doi.org/10.3390/sports13020028

[8] H. Sarmento, D.V. Martinho, É.R. Gouveia, J. Afonso, P. Chmura, A. Field, N.O. Savedra, R. Oliveira, G. Praça, R. Silva, J. Barrera-Díaz, F.M. Clemente, The influence of playing position on physical, physiological, and technical demands in adult male soccer matches: A systematic scoping review with evidence gap map, Sports Medicine 54(11)(2024) 2841–2864.
https://doi.org/10.1007/s40279-024-02088-z

[9] J. Baker, S. Wilson, K. Johnston, N. Dehghansai, A. Koenigsberg, S. De Vegt, N. Wattie, Talent research in sport 1990–2018: A scoping review, Frontiers in Psychology 11(2020) 607710.
https://doi.org/10.3389/fpsyg.2020.607710

[10] J. Baker, N. Wattie, Innate talent in sport: Separating myth from reality, Current Issues in Sport Science (CISS) 3(2018) 006.
https://doi.org/10.36950/CISS_2018.006

[11] S. Cobley, J. Baker, J. Schorer, Talent Identification and Development in Sport: An Introduction to a Field of Expanding Research and Practice, in: J. Baker, S. Cobley, J. Schorer (Eds.), Talent Identification and Development in Sport, Routledge, 2020 (1–16).

[12] A. Güllich, P. Larkin, Talent identification and talent promotion, in: A.M. Williams, P. Ford, B. Drust (Eds.), Science and Soccer, Routledge, London, 2023 (363–381).
https://doi.org/10.4324/9781003148418-27

[13] H. Sarmento, M.T. Anguera, A. Pereira, D. Araújo, Talent identification and development in male football: A systematic review, Sports medicine 48(4)(2018) 907–931.
https://doi.org/10.1007/s40279-017-0851-7

[14] M. King, M. Brown, J. Cox, R. McLellan, C. Towlson, S. Barrett, Talent identification in soccer: The influence of technical, physical and maturity-related characteristics on a national selection process, Plos one 19(3)(2024) e0298359.
https://doi.org/10.1371/journal.pone.0298359

[15] A.B.T. McAuley, J. Baker, K. Johnston, A.L. Kelly, Artificial intelligence in talent identification and development in sport, in: C. Dindorf, E. Bartaguiz, F. Gassmann, M. Fröhlich (Eds.), Artificial Intelligence in Sports, Movement, and Health, Springer, Cham, 2024 (255–270).
https://doi.org/10.1007/978-3-031-67256-9_15

[16] Reuters, Data crunching keeps England ahead of the game, AI to unearth new gems. <https://www.reuters.com/sports/soccer/data-crunching-keeps-england-ahead-game-ai-unearth-new-gems-2024-05-15/>, 2024.

[17] W. Ju, D. Doran, R. Hawkins, M. Evans, A. Laws, P.S. Bradley, Contextualised high-intensity running profiles of elite football players with reference to general and specialised tactical roles, Biology of Sport 40(1)(2023) 291–301. https://doi.org/10.5114/biolsport.2023.116003
[18] I.T. Teoldo, E.N. Mezzadri, F. Cardoso, G. Machado, Speed of decision-making as a key element for professional and academy soccer players' performances, Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación 50(4) (2023) 1195–1203. https://doi.org/10.47197/retos.v50.100355
[19] M. Slimani, P.T. Nikolaidis, Anthropometric and physiological characteristics of male Soccer players according to their competitive level, playing position and age group: A systematic review, Journal of Sports Medicine and Physical Fitness, 59(1)(2017) 141–163. https://doi.org/10.23736/s0022-4707.17.07950-6
[20] L. Bortnik, S. Bruce-Low, J. Burger, J. Alexander, D. Harper, R. Morgans, C. Carling, K. McDaid, D. Rhodes, Physical match demands across different playing positions during transitional play and high-pressure activities in elite soccer, Biology of Sport 41(2)(2024) 73–82. https://doi.org/10.5114/biolsport.2024.131815
[21] R. Villaseca-Vicuña, E. Molina-Sotomayor, S. Zabaloy, J.A. Gonzalez-Jurado, Anthropometric profile and physical fitness performance comparison by game position in the Chile women's senior national football team, Applied Sciences 11(5)(2021) 2004. https://doi.org/10.3390/app11052004
[22] J. Fuhre, A. Øygard, S.A. Sæther, Coaches' criteria for talent identification of youth male soccer players, Sports (Basel) 10(2)(2022) 14. https://doi.org/10.3390/sports10020014
[23] M. Koudellis, C. Tsouloupas, M. Christou, G. Aphamis, G.C. Bogdanis, C.D. Giannaki, Physical fitness, psychological characteristics, and game performance in youth male soccer players of different levels of competition, International Journal of Performance Analysis in Sport 25(2)(2025) 290–304. https://doi.org/10.1080/24748668.2024.2411107
[24] S. Toselli, A. Grigoletto, M. Mauro, Anthropometric, body composition and physical performance of elite young Italian football players and differences between selected and unselected talents, Heliyon 10(16)(2024) e35992. https://doi.org/10.1016/j.heliyon.2024.e35992
[25] T. Koopmann, I. Faber, J. Baker, J. Schorer, Assessing technical skills in talented youth athletes: A systematic review, Sports Medicine 50(9)(2020) 1593–1611. https://doi.org/10.1007/s40279-020-01299-4
[26] T.V. Camata, A.H. Hunter, N.M.A. Smith, M.S. Crowther, M.A. Costa, F.A. Moura, R.S. Wilson, Influence of age and body size on the dribbling performance of young elite soccer players: A cross-sectional descriptive study, Journal of Functional Morphology and Kinesiology 10(2)(2025) 118. https://doi.org/10.3390/jfmk10020118
[27] A.H. Hunter, N.M.A. Smith, T.V. Camata, M.S. Crowther, A. Mather, N.M. Souza, L.F. Ramos-Silva, N.F. Pazetto, F.A. Moura, R.S. Wilson, Age- and size-corrected kicking speed and accuracy in elite junior soccer players, Science and Medicine in Football 6(1)(2022) 29–39. https://doi.org/10.1080/24733938.2021.1899274
[28] C. Yiannaki, D.J. Barron, D. Collins, C. Carling, Match performance in a reference futsal team during an international tournament–implications for talent development in soccer, Biology of sport 37(2)(2020) 147–156. https://doi.org/10.5114/biolsport.2020.93040
[29] U.S. Rozmatovich, D. Elyor, Teaching attack tactics to football players, International Journal of Research in Commerce, IT, Engineering and Social Sciences 16(10)(2022) 125–132. https://www.gejournal.net/index.php/IJRCIESS/article/view/1119
[30] R.S. Wilson, N.M.A. Smith, S.P. Ramos, F.G. Caetano, M.A. Rinaldo, P.R.P. Santiago, S.A. Cunha, F.A. Moura, Dribbling speed along curved paths predicts attacking performance in match-realistic one vs. one soccer games, Journal of sports sciences 37(9)(2019) 1072–1079. https://doi.org/10.1080/02640414.2018.1544110
[31] H. Zhao, H. Chen, S. Yu, B. Chen, Multi-objective optimization for football team member selection, IEEE Access 9(2021) 90475–90487. https://doi.org/10.1109/ACCESS.2021.3091185
[32] R. Ferreira, S. Pereira, J. Ribeiro, J. Garganta, D. Barreira, The Defensive Golden Index: A novel method to rank football player defensive performance for Fútbol Club Barcelona, Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology 236(3)(2022) 209–220. https://doi.org/10.1177/17543371211008794
[33] R. Freitas, A. Volossovitch, C.H. Almeida, V. Vleck, Elite-level defensive performance in football: A systematic review, German Journal of Exercise and Sport Research 53(4)(2023) 458–470. https://doi.org/10.1007/s12662-023-00900-y
[34] P. Prieto-González, V. Martín, A. Sal-de-Rellán, Impact of defensive team variables on goals conceded in the first division of the Spanish soccer league: A 10-year study, Biology of Sport 42(3)(2025) 17–28.

https://doi.org/10.5114/biolsport.2025.145914
[35] A.A. Artikov, Analysis of specialised tools for enhancing the accuracy of technical skills in football, Mental Enlightenment Scientific-Methodological Journal 6(2)(2025) 77–87.
https://mentaljournal-jspu.uz/index.php/mesmj/article/view/817
[36] D. Haroune, B. Ali, S. Chachou, The relative importance of morphological, physical and skill requirements for selecting talented U13 football players, SPORT TK-Revista EuroAmericana de Ciencias del Deporte 13(S1)(2024) 38.
https://doi.org/10.6018/sportk.611651
[37] B.W.C. Jerome, M. Stoeckl, B. Mackriell, C.W. Dawson, D.T.P. Fong, J.P. Folland, Evidence for a new model of the complex interrelationship of ball possession, physical intensity and performance in elite soccer, Scandinavian Journal of Medicine & Science in Sports 34(1)(2024) e14546.
https://doi.org/10.1111/sms.14546
[38] E.M. Rocha-Lima, I.W. Tertuliano, C.N. Fischer, The influence of ball possession, passes and shots on target in winning premier league football matches, Research, Society and Development 10(8)(2021) e55110817824.
https://doi.org/10.33448/rsd-v10i8.17824
[39] M. Kapsalis, S. Plakias, A. Kyranoudis, A. Zarkadoula, A. Lathoura, T. Tsatalas, Exploring the impact of possession-based performance indicators on goal scoring in elite football leagues, Journal of Physical Education and Sport 23(8)(2023) 2004–2015.
https://doi.org/10.7752/jpes.2023.08231
[40] S.H. Wang, Y. Qin, Y. Jia, K.E. Igor, A systematic review about the performance indicators related to ball possession, PLoS One 17(3)(2022) e0265540.
https://doi.org/10.1371/journal.pone.0265540
[41] H. Lee, B.A. Tama, M. Cha, Prediction of Football Player Value Using Bayesian Ensemble Approach. <https://arxiv.org/abs/2206.13246>, 2022.
[42] G. Shan, X. Zhang, Soccer scoring techniques—A biomechanical re-conception of time and space for innovations in soccer research and coaching, Bioengineering (Basel) 9(8)(2022) 333.
https://doi.org/10.3390/bioengineering9080333
[43] G. Jordet, K.M. Aksum, D.N. Pedersen, A. Walvekar, A. Trivedi, A. McCall, A. Ivarsson, D. Priestley, Scanning, contextual factors, and association with performance in English Premier League footballers: An investigation across a season, Frontiers in psychology 11(2020) 553813.
https://doi.org/10.3389/fpsyg.2020.553813
[44] R. Sánchez-López, I. Echeazarra, J. Castellano, Systematic review of declarative tactical knowledge evaluation tools based on game-play scenarios in soccer, Quality & Quantity 56(4)(2022) 1–20.
https://doi.org/10.1007/s11135-021-01204-9
[45] T.L.G. Bergkamp, W.G.P. Frencken, A.S.M. Niessen, R.R. Meijer, R.J.R. den Hartigh, How soccer scouts identify talented players, European Journal of Sport Science 22(7)(2022) 994–1004.
https://doi.org/10.1080/17461391.2021.1916081
[46] F.D.S.L. Cardoso, J. Afonso, A. Roca, I. Teoldo, The association between perceptual-cognitive processes and response time in decision making in young soccer players, Journal of Sports Sciences 39(8)(2021) 926–935.
https://doi.org/10.1080/02640414.2020.1851901
[47] E. Gonçalves, F. Noce, M.A.M. Barbosa, A.J. Figueiredo, D. Hackfort, I. Teoldo, Correlation of the peripheral perception with the maturation and the effect of the peripheral perception on the tactical behaviour of soccer players, International Journal of Sport and Exercise Psychology 18(5)(2020) 687–699.
https://doi.org/10.1080/1612197X.2017.1329222
[48] F.C. Klingner, B.C. Huijgen, R.J. Den Hartigh, M. Kempe, Technical–tactical skill assessments in small-sided soccer games: A scoping review, International Journal of Sports Science & Coaching 17(4)(2022) 885–902.
https://doi.org/10.1177/17479541211049532
[49] F. Dambroz, I. Teoldo, Better decision-making skills support tactical behaviour and reduce physical wear under physical fatigue in soccer, Frontiers in Physiology 14(2023) 1116924.
https://doi.org/10.3389/fphys.2023.1116924
[50] G. Machado, S. González-Víllora, I. Teoldo, Selected soccer players are quicker and better decision-makers in elite Brazilian youth academies, International Journal of Performance Analysis in Sport 23(2)(2023) 65–82.
https://doi.org/10.1080/24748668.2023.2181609
[51] F. Skala, E. Zemková, Effects of acute fatigue on cognitive performance in team sport players: Does it change the way they perform? A scoping review, Applied Sciences 12(3)(2022) 1736.
https://doi.org/10.3390/app12031736
[52] A.J. McBurnie, J. Parr, D.M. Kelly, T. Dos'Santos, & Dos' Santos, Multidirectional speed in youth soccer players: Programming considerations and practical applications, Strength & Conditioning Journal 44(2)(2022) 10–32.
https://doi.org/10.1519/SSC.0000000000000657
[53] Ł. Bojkowski, P. Kalinowski, R. Śliwowski, M. Tomczak, The importance of selected coordination motor skills for an individual football player's effectiveness in a game, International journal of environmental research and public health 19(2)(2022) 728.
https://doi.org/10.3390/ijerph19020728

[54] B. Nurkadri, B. Daulay, F. Azmi, Coordination and agility: How is the correlation in improving soccer dribbling skills? Journal Sport Area 6(2)(2021) 147–161.
[55] F.T. González-Fernández, H. Sarmento, A. Castillo-Rodríguez, R. Silva, F.M. Clemente, Effects of a 10-week combined coordination and agility training program on young male soccer players, International Journal of Environmental Research and Public Health 18(19)(2021) 10125.
https://doi.org/10.3390/ijerph181910125
[56] W. Young, R. Rayner, S. Talpey, It's time to change direction on agility research: A call to action, Sports medicine-open 7(1)(2021) 12.
https://doi.org/10.1186/s40798-021-00304-y
[57] Q. He, D. Araújo, K. Davids, Y.H. Kee, J. Komar, Functional adaptability in playing style: A key determinant of competitive football performance, Adaptive Behavior 31(6)(2023) 545–558.
https://doi.org/10.1177/10597123231178942
[58] J. Conde-Pipó, G. de Sousa Pinheiro, D.F. Pombal, L.M. Toscano, J.E.G. Llamas, J.M.C. Gallardo, B. Requena, M. Mariscal-Arcas, Investigating acceleration and deceleration patterns in elite youth football: The interplay of ball possession and tactical behavior, Applied Sciences 14(10)(2024) 4336.
https://doi.org/10.3390/app14104336
[59] G. Lewis, C. Towlson, P. Roversi, C. Domogalla, L. Herrington, S. Barrett, Quantifying volume and high-speed technical actions of professional soccer players using foot-mounted inertial measurement units, PLOS One 17(2)(2022) e0263518.
https://doi.org/10.1371/journal.pone.0263518
[60] R.S. Wilson, N.M.A. Smith, N. Melo de Souza, F.A. Moura, Dribbling speed predicts goal-scoring success in a soccer training game, Scandinavian journal of medicine & science in sports 30(11)(2020) 2070–2077.
https://doi.org/10.1111/sms.13782
[61] A. Ardiansyah, Sumaryanto, Komarudin, M.I. Sabillah, Rusdin, E. Irawan, Anhar, Integrated training plan for youth soccer players: Focus on SABC, Retos: nuevas tendencias en educación física, deporte y recreación (53)(2024) 418–426.
https://doi.org/10.47197/retos.v53.102317
[62] D. Friebe, J. Sieland, H. Both, F. Giesche, C. Haser, T. Hülsdünker, F. Pfab, L. Vogt, W. Banzer, Validity of a motor–cognitive dual-task agility test in elite youth football players, European journal of sport science 24(8)(2024) 1056–1066.
https://doi.org/10.1002/ejsc.12153
[63] J.D.D. Benítez-Sillero, L.M. Martínez-Aranda, M. Sanz-Matesanz, M. Domínguez-Escribano, Determining factors of psychological performance and differences among age categories in youth football players, Sustainability 13(14)(2021) 7713.
https://doi.org/10.3390/su13147713
[64] A. Chrétien, M. Hayotte, A. Vuillemin, F.D.A. d'Arripe Longueville, Resilience profiles of elite athletes and their associations with health-related behaviors, well-being, and performance: A latent profile analysis, Psychology of Sport and Exercise 74(2024) 102689.
https://doi.org/10.1016/j.psychsport.2024.102689
[65] G. Doncaster, D. Medina, F. Drobnic, A.J. Gómez-Díaz, V. Unnithan, Appreciating factors beyond the physical in talent identification and development: Insights from the FC Barcelona sporting model, Frontiers in sports and active living 2(2020) 91.
https://doi.org/10.3389/fspor.2020.00091
[66] D.F. Gucciardi, Mental Toughness, in: G. Tenenbaum, R.C. Eklund (Eds.), Handbook of Sport Psychology, John Wiley & Sons, Inc., 2020 (101-120).
https://doi.org/10.1002/9781119568124.ch6
[67] A. İslam, H.İ. Ceylan, M.E. Öztürk, The effect of mental energy on psychological skills and courage in soccer players, CBÜ Beden Eğitimi ve Spor Bilimleri Dergisi 18(2)(2023) 702–717.
https://doi.org/10.33459/cbubesbd.1344330
[68] M.F. da Silva, A. Novillo, A. Aleta, R.L. del Campo, R. Resta, Y. Moreno, J.M. Buldu, Interplay Between Pitch Control and Top Speed in Soccer: The Stamina Factor. <https://arxiv.org/abs/2504.18250>, 2025.
[69] P. Larkin, D. Cocić, D.T. Hendry, A.M. Williams, D. O'Connor, M. Bilalić, Gritting one's way to success–Grit explains skill in elite youth soccer players beyond (deliberate) practice, Psychology of Sport and Exercise 64(2023) 102328.
https://doi.org/10.1016/j.psychsport.2022.102328
[70] P. Makar, R.M. Musa, R.M. Silva, J. Muracki, R. Trybulski, E. Altundağ, M. Altaca, W. Kuczmik, R. Studnicki, Z. Akyildiz, Locomotor performance parameters as predictors of high-performing male soccer teams. A multiple-season study on professional soccer, Scientific Reports 14(1)(2024) 28547.
https://doi.org/10.1038/s41598-024-80181-z
[71] E. Konter, A. Gledhill, Y.C. Kueh, G. Kuan, Understanding the relationship between sport courage and female soccer performance variables, International journal of environmental research and public health 19(8)(2022) 4654.
https://doi.org/10.3390/ijerph19084654
[72] S. Llana, B. Burriel, P. Madrero, J. Fernández, Is It Worth the Effort? Understanding and Contextualizing Physical Metrics in Soccer. <https://arxiv.org/abs/2204.02313>, 2022.

[73] I. Yevchenko, A. Masliuk, S. Myronets, K. Dubinina, N. Podolyak, Players' individual characteristics affecting football team cohesion, Amazonia Investiga 11(60)(2022) 113–120.
https://doi.org/10.34069/AI/2022.60.12.11
[74] L. Bonetti, P. Petrovic, Oxford University Department of Psychiatry, Elite football players have higher levels of cognitive abilities compared to the general population—New study, University of Oxford. <https://www.psych.ox.ac.uk/news/elite-football-players-have-higher-levels-of-cognitive-abilities-compared-to-the-general-population-new-study>, 2025.
[75] J.M. García-Ceberino, M.G. Gamero, S. Feu, S.J. Ibáñez, Differences in technical and tactical learning of football according to the teaching methodology: A study in an educational context, Sustainability 12(16)(2020) 6554.
https://doi.org/10.3390/su12166554
[76] A. Roca, P.R. Ford, D. Memmert, Perceptual-cognitive processes underlying creative expert performance in soccer, Psychological Research 85(3)(2021) 1146–1155.
https://doi.org/10.1007/s00426-020-01320-5
[77] S. McLean, P.M. Salmon, A.D. Gorman, K. Dodd, C. Solomon, The communication and passing contributions of playing positions in a professional soccer team, Journal of Human Kinetics 77(2021) 223–234.
https://doi.org/10.2478/hukin-2020-0052
[78] F.M. Leo, E. Filho, M.A. López-Gajardo, T. García-Calvo, I. González-Ponce, The relationship among intra-group communication, transactive memory systems, collective efficacy and team performance: A structural equation model analysis with Elite Footballers, European Journal of Sport Science 23(4)(2023) 599–606.
https://doi.org/10.1080/17461391.2022.2049373
[79] J.D. Shah, C. Iyer, M.S. Dasgupta, Using MCDM techniques for talent identification and management in sports, in: Proc. International Conference on Sports Engineering, 2023.
https://doi.org/10.1007/978-981-97-8297-0_11
[80] M.A.R. Alves, M.V.D.S. de Souza Lencina, M.J. Paes, J.M.F. Stefanello, Collective efficacy in soccer teams: A systematic review, Psicologia: Reflexão e Crítica 34(2021) 18.
https://doi.org/10.1186/s41155-021-00183-y
[81] H. Ishii, Y. Takai, Y. Marui, Y. Yamazaki, Y. Kato, H. Kori, Uncovering Influence of Football Players' Behaviour on Team Performance in Ball Possession Through Dynamical Modelling. <https://arxiv.org/abs/2504.06574>, 2025.
[82] D. McEwan, E.J. Shah, K.L. Crawford, P.C. Jackman, M.D. Hoffmann, E. Cardinal, M.W. Bruner, C.D. McLaren, A.J. Benson, The psychometric properties of two brief measures of teamwork in sport, Journal of Sport and Exercise Psychology 45(6)(2023) 325–336.
https://doi.org/10.1123/jsep.2023-0147
[83] M. Alavikia, A.R. Arshi, Position specific talent identification protocols for football players, in: Proc. 10th International Congress on Sport Sciences, 2017.
https://doi.org/10.22089/10THCONF.2017.351
[84] R.H. Bemthuis, Lost in Models? Structuring Managerial Decision Support in Process Mining with Multi-criteria Decision Making. <https://arxiv.org/abs/2505.10236>, 2025.
[85] J.J. Thakkar, Multi-criteria Decision Making, Springer, Singapore, 2021.
https://doi.org/10.1007/978-981-33-4745-8
[86] S. Opricovic, G.H. Tzeng, Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS, European journal of operational research 156(2)(2004) 445–455.
https://doi.org/10.1016/S0377-2217(03)00020-1
[87] K.T. Atanassov, Intuitionistic fuzzy sets, Fuzzy Sets and Systems 20(1)(1986) 87–96.
https://doi.org/10.1016/S0165-0114(86)80034-3
[88] P. Gao, RETRACTED: VIKOR method for intuitionistic fuzzy multi-attribute group decision-making and its application to teaching quality evaluation of college English, Journal of Intelligent & Fuzzy Systems 42(6)(2022) 5189–5197.
https://doi.org/10.3233/JIFS-211749
[89] I. Yilmaz, Evaluating Industry 4.0 barriers by Intuitionistic fuzzy VIKOR method, in: B. Erdebilli, G.W. Weber (Eds.), Multiple Criteria Decision Making with Fuzzy Sets: MS Excel® and Other Software Solutions, Springer, Cham, 2022 (167–178).
https://doi.org/10.1007/978-3-030-98872-2_11
[90] E.L. Amalia, D.S.E. Ikawati, M.A.P. Laksana, Decision supporting system for Malang city baseball and softball athletes selection using the Vikor method, International journal of science engineering and information technology 5(1)(2020) 218–221.
https://doi.org/10.21107/ijseit.v5i1.8101
[91] M. Aydın, S. Avcı, Z. Aladağ, Futbolcu performanslarının VIKOR yöntemi ile değerlendirilmesi, Akdeniz Spor Bilimleri Dergisi 4(1)(2021) 24–39.
https://doi.org/10.38021/asbid.873554
[92] F.E. Boran, S. Genç, M. Kurt, D. Akay, A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method, Expert systems with applications 36(8)(2009) 11363–11368.
https://doi.org/10.1016/j.eswa.2009.03.039

[93] G. Yalçın, H. Genç, The evaluation of analytical thinking skills and reaction tests on performance in female football players: Their impact on in-game decision-making processes, Sport Sciences for Health 21(4)(2025) 2889–2897. https://doi.org/10.1007/s11332-025-01495-7

[94] B. Katanic, R. Radakovic, S. Djordjevic, K. Govindasamy, V.A. Geantă, A.I. Băltean, M. Stankovic, Differences in match running performance of elite male football players relative to playing position, Journal of Men's Health 21(4) (2025) 89–94. https://www.jomh.org/articles/10.22514/jomh.2025.055

[95] D. Raabe, H. Biermann, M. Bassek, D. Memmert, R. Rein, The dual problem of space: Relative player positioning determines attacking success in elite men's football, Journal of Sports Sciences 42(19)(2024) 1821–1830. https://doi.org/10.1080/02640414.2024.2414363

[96] L.E. Rentz, C.L. Brandmeir, B.G. Rawls, S.M. Galster, Reactive task performance under varying loads in Division I collegiate soccer athletes, Frontiers in Sports and Active Living 3(2021) 707910. https://doi.org/10.3389/fspor.2021.707910

[97] V. Santos, N. Casanova, P. Marconcin, R. Willig, J. Vidal-Conti, D. Soares, F. Flôres, Physical fitness as a predictor of reaction time in soccer-playing children, PloS one 20(3)(2025) e0320147. https://doi.org/10.1371/journal.pone.0320147