

Football athlete talent selection using the analytical hierarchy process

KHARRIS NUR QOTIMAH¹, ALEN RISMAYADI^{2*}, GERALDI NOVIAN³

^{1,2*,3}Study Program of Sport Physical Coaching, Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, INDONESIA

Published online: October 31, 2024

Accepted for publication: October 15, 2024

DOI:10.7752/jpes.2024.10273

Abstract:

The process of talent selection in sports faces unique challenges, complicating the identification of appropriate candidates. These challenges arise from the absence of a thorough and equitable method for evaluating talent, which tends to make the talent selection process subjective and has negative impact on athletes. This study aims to establish priority criteria for selecting junior football athletes using the analytical hierarchy process (AHP). A mixed methods research (MMR) approach, which combines both quantitative and qualitative techniques, was used in this investigation. The study identified three main criteria, further detailed in fourteen sub-criteria, based on discussions with football coaches and administrators. Data analysis was performed using the AHP method. This study showed that physical was a priority, anthropometry was a second priority, and technique was a third priority in the selection process for junior soccer athlete talent. In addition, the results of the study based on sub-criteria showed that strength was a priority in physical criteria, height was a priority in anthropometry criteria, and shooting was a priority in technique criteria. So, it can be concluded that the AHP method is the right method to use in determining the priority of junior football athlete talent selection. The AHP method produces 14 sub-criteria which are divided into 3 main criteria, where physical is the number one priority in the junior football athlete talent selection process. This study recommends applying the AHP method in the talent selection process for athletes in other sports to achieve results with a high level of objectivity.

Keywords: Analytical hierarchy process (AHP) method, talent selection, junior athletes, football

Introduction

The analytical hierarchy process (AHP), developed by Thomas L. Saaty, aids in solving complex problems by organizing a hierarchy of criteria, stakeholders, and results. It incorporates multiple considerations to establish weights or priorities (Munthafa et al., 2017). The advantage of using problem-solving methods over others lies in their hierarchical structure, which reflects the chosen criteria down to the most detailed sub-criteria. This approach considers validity while accounting for tolerance limits regarding inconsistencies in the criteria and alternatives selected by decision-makers. It is believed that this method offers a fair and suitable way to perform selection or identification processes in specific cases. Particularly in sports, the AHP method has been extensively used across various sports practices (Erturan-Ogut & Kula, 2023; Li et al., 2021; Nisel & Özdemir, 2016).

In this study, the authors use the AHP method to select talent among junior soccer athletes. Talent selection in football encompasses multiple criteria, including technical, physical, tactical, and psychological abilities. However, for the junior age category, not all criteria are applicable as indicators because the athletes are still in a stage of growth and development, making it feasible for their skills to be shaped and enhanced during the training process. This aligns with previous studies, which indicate that at a junior age, children should prioritize physical literacy and movement skills to ensure strong performance in sports (Beaudoin et al., 2015; Nolte et al., 2017; Tenforde et al., 2022).

The selection process is often subjective and can be influenced by the personal preferences of coaches, managers, administrators, or other parties who should not hold authority in this decision (Winata, 2022). Thus, AHP effectively addresses multi-objective and multi-criteria problems by comparing preferences for each criterion in a pre-established hierarchy. This model is a comprehensive decision-making tool, transforming complex and unstructured scenarios into manageable criteria by assigning subjective values to the relative importance of each variable and identifying which variables hold the highest priority in influencing the outcome (Parhusip, 2019).

The authors performed further research on AHP and reviewed studies comparing the AHP method with Promethee. These studies revealed that AHP was effective in solving multi-criteria decision-making problems owing to its ability to assign weights and structure criteria hierarchies using diverse preferences and weight functions (Nugroho, 2016). Furthermore, the study demonstrates that the decision support system built using AHP enables the student affairs department to select students for events more quickly, accurately, and objectively. In contrast, the Promethee method lacks the ability to determine weights and establish a criteria

hierarchy, and it does not provide consistency safeguards when assigning weights, as AHP does (Julianto et al., 2014; M. Nur & Wijaya, 2023).

In the field of sports, previous studies that analyzed and developed selection models using key indicators and criteria in rowing identified five primary criteria: (1) anthropometry, (2) physiology, (3) biomechanics, (4) technique, and (5) psychology (Nurjaya et al., 2020). Notably, this research focused on elite athletes who progressed through a tiered selection process from amateur levels. This study introduces innovation using the AHP method for talent selection among junior football athletes. AHP is recognized as a comprehensive and rational decision support method that effectively addresses complex criteria issues across various alternatives, considering both qualitative and quantitative factors. Therefore, this research aims to determine priority criteria for talent selection for junior football athletes using the AHP method.

Materials and Methods

This study used mixed methods research (MMR), integrating both quantitative and qualitative approaches. MMR offers a more comprehensive and clearer understanding compared to the use of each method individually (Saparudin & Arizona, 2022). MMR is primarily used to address the limitations of qualitative and quantitative approaches in sports-related studies (Putra 2017). Its goal is to integrate both methods, leading to the development of products that considerably enhance sports science research (Kay & Kucera, 2018; Sains et al., 2020). The rationale for selecting this method is its ability to provide accurate and consistent measurements, minimizing subjective bias.

In this study, the authors assessed the talents of soccer athletes by establishing primary criteria and sub-criteria for decision-making. These criteria were formulated through discussions with coaches and football administrators, who served as research informants. Information was collected to prioritize criteria based on anthropometric, physical, and technical aspects of football. Additionally, these criteria were detailed in 14 sub-criteria that directly impact the ranking process. The selection of criteria and sub-criteria was performed intentionally, drawing on insights from previous studies across various perspectives. Subsequently, data analysis was performed using the AHP application. The criteria and sub-criteria for football athlete talent selection are detailed in Table 1.

Table 1. Criteria and sub-criteria for football athletes

Criteria	Sub-criteria	Description	Reference
Anthropometry (KU 1)	Body weight (ANT 1)	Body weight refers to the individual's weight measured with minimal clothing and without additional equipment, using a scale and recorded in kilograms.	(Ackerman et al., 2015; Rusiawati & Wijana, 2022)
	Body height (ANT 2)	Height is an anthropometric measurement that indicates an individual's growth and stature.	(Ackerman et al., 2015; Joksimović et al., 2019; Patel et al., 2019)
	Body fat (ANT 3)	Normal body fat levels for women range from 25% to 31%, while for men, the acceptable range is between 18% and 25%.	(Faudji, 2023; Gardasevic et al., 2019, 2020)
	Body mass index (ANT 4)	Body mass index (BMI) indicates whether a person's weight is classified as normal, ideal, overweight, or obese.	(Faudji, 2023; Gardasevic et al., 2019, 2020)
Physique (KU 2)	Flexibility (PHY-1)	A person's ability to move freely without pain involves the coordinated function of muscles, tendons, and ligaments.	(Bogalho et al., 2022; de Lima-E-Silva et al., 2020; Turna & Alp, 2020)
	Speed (PHY- 2)	Speed refers to a person's ability to perform cyclical movements in the shortest possible time.	(Hands & Janse de Jonge, 2020; Rhodes et al., 2021; Turna & Alp, 2020)
	Agility (PHY- 3)	Agility is a person's ability to change direction quickly while moving in an acyclic manner.	(Krolo et al., 2020; Milanović et al., 2014; Morral-Yepes et al., 2022)
	Strength (PHY- 4)	Strength refers to a person's ability to exert maximal muscle power over both short and extended periods.	(Ness et al., 2016; Peek et al., 2018; Turna & Alp, 2020)
	Endurance (PHY- 5)	Endurance is measured by the maximum amount of oxygen the body can take in and utilize during intense exercise.	(Atan & Akyol, 2014; Lefebvre et al., 2023; Polat et al., 2019; Zakiyuddin. R., 2016)

Technical (KU-3)	Kicking (TEC-1)	The primary technique that must be mastered in soccer is the technique of kicking the ball.	(Blair et al., 2018; Bonney et al., 2020; Gaspar et al., 2019; González-Víllora, S. 1; García-López, L.M.2 y Contreras-Jordán, 2015; Hart et al., 2014; Peacock & Ball, 2019)
	Dribbling (TEC-2)	The technique of dribbling involves carrying the ball and changing direction with quick foot touches.	(Brink et al., 2023; Dawud, 2020; Dinata et al., 2020; Karo Karo et al., 2020; Razali et al., 2021)
	Shooting (TEC-3)	Strike the ball with your foot's strength to accurately aim for the opponent's goal.	(Afriзал, 2019; Greer et al., 2021; Laaksonen et al., 2018; Liu et al., 2014; Schulze et al., 2018)
	Stopping (TEC-4)	The stopping movement in football involves controlling the ball until it is effectively stopped.	(Maneiro et al., 2019; Mashud et al., 2019; Ötting & Karlis, 2023; Sarmiento et al., 2014; Sukamto et al., 2020)
	Passing (TEC-5)	The most commonly used basic technique in soccer is passing the ball.	(Bozkurt et al., 2020; Clemente et al., 2016; Esposito & Raiola, 2020; Rezaee et al., 2016; Trajkov, 2020)

Then, the authors developed a hierarchical structure of criteria and sub-criteria used in this research, as illustrated in Figure 1.

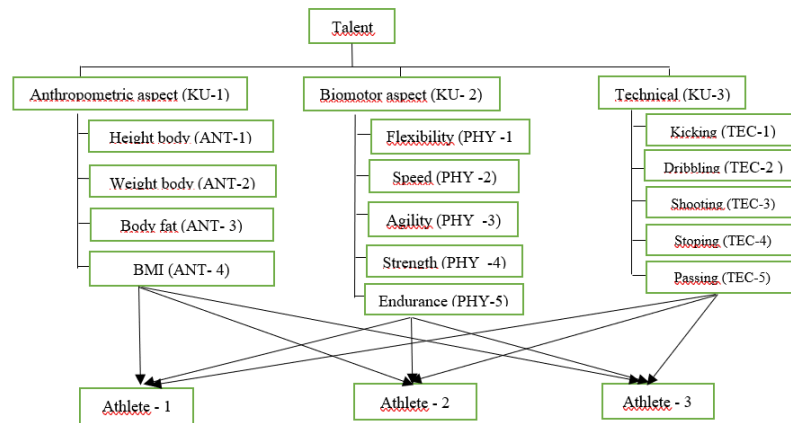


Figure 1. Typical hierarchical structure (Krolo et al., 2020)

Next, the authors created a comparative evaluation scale for this research, presented in Table 2.

Table 2. Evaluation comparison scale (Astuti et al., 2020)

Score	Meaning	Description
1	Equally important	Both elements exert equal influence.
3	One is more important than the other	Experience and judgment strongly favor one element compared to its counterpart.
5	Quite important	Experience and judgment indicate a preference for one activity over another.
7	Very important	Experience and judgment indicate a strong preference for one activity compared to another.
9	More important	One element is preferred over its counterpart with the highest level of confidence.
2,4,6,8	The middle value between two adjacent values	When a compromise is necessary.

Results

After obtaining the data, the authors processed and analyzed the data, presenting the results in table format.

Table 3. Outcomes of Prioritizing Selection Criteria.

Criteria	Priority	Rank	(+)	(-)
Anthropometry	21.7%	2	4.1%	4.1%
Physique	71.7%	1	13.7%	13.7%
Technical	6.6%	3	1.3%	1.3%

Number of comparisons = 3

Consistency ratio (CR) = 3.9%

Table 3 presents the results of prioritizing the three previously established criteria, which yielded a consistency ratio (CR) of 3.9%. The results indicate that physical characteristics are the top priority, accounting for 71.7%, followed by anthropometry at 21.7%, and engineering at 6.6%. This highlights that physicality is the foremost consideration in the talent selection process for junior football athletes, with anthropometrics as the second priority and technique as the third. Next, the authors present the results of the weight calculations derived from the main eigenvectors of the decision matrix on the criteria, as shown in Table 4.

Table 4. Decision matrix results for criteria selection

	Anthropometry	Physique	Technical
Anthropometry	1	0.25	4.00
Physique	4.00	1	9.00
Technical	0.25	0.11	1

Principal eigenvalue = 3.037

Eigenvector solution: 4 iterations, $\delta = 1.7E-9$

Table 4 presents the results of the selection criteria decision matrix, showing a principal eigenvalue of 3.037. As indicated in Table 4, the weight calculations are as follows: between anthropometry and physical attributes is 0.25, between anthropometry and technique is 4.00, between physical attributes and anthropometry is 4.00, between physical attributes and engineering is 9.00, between engineering and anthropometry is 0.25, and between engineering and physical attributes is 0.11. Then, the authors provide the results of the prioritization of anthropometric sub-criteria, detailed in Table 5.

Table 5. Results of prioritizing anthropometric sub-criteria

Sub-criteria	Priority	Rank	(+)	(-)
Body weight	17.7%	2	3.7%	3.7%
Body height	67.4%	1	17.6%	17.6%
Body fat	5.7%	4	1.8%	1.8%
Body mass index	9.3%	3	1.3%	1.3%

Number of comparisons = 6 Consistency ratio (CR) = 3.2%

Table 5 presents the results of prioritizing the four established criteria, with a CR of 3.2%. The findings indicate that body height ranks as the top priority at 67.4%, followed by body weight at 17.7%, BMI at 9.3%, and body fat at 5.7%. This demonstrates that body height is the foremost criterion in the talent selection process for junior football athletes, followed by body weight in second place, body fat in third, and BMI in fourth. Next, the authors present the results of the weight calculations derived from the main eigenvector of the decision matrix for the criteria, as shown in Table 6.

Table 6. Results of the anthropometric sub-criteria decision matrix

	Body Weight	Body Height	Body Fat	Body Mass Index
Body Weight	1	0.20	4.00	2.00
Body Height	5.00	1	8.00	8.00
Body Fat	0.25	0.12	1	0.50
Body Mass Index	0.50	0.12	2.00	1

Principal eigenvalue = 4.087

Eigenvector solution: 4 iterations, $\delta = 2.0E-8$

Table 6 presents the results of the selection criteria decision matrix, with a principal eigenvalue of 4.087. Based on Table 6, the weight calculation results are as follows: between body weight and the body height is 0.20; between body weight and body fat is 4.00; between body weight and BMI is 2.00; between body height and body weight is 5.00; between body height and body fat is 8.00; between body height and BMI is 8.00; between body fat and body weight is 0.25; between body fat and body height is 0.12; between body fat and BMI is 0.50; between BMI and body weight is 0.50; between BMI and body height is 0.12; and between BMI and body fat is 2.00. Next, the authors present the results of the prioritization of physical sub-criteria, which are shown in Table 7.

Table 7. Results of determining physical sub-criteria

Sub-criteria	Priority	Rank	(+)	(-)
Flexibility	6.0%	4	3.3%	3.3%
Speed	28.5%	2	10.6%	10.6%
Agility	5.5%	5	1.7%	1.7%
Strength	35.1%	1	14.0%	14.0%
Endurance	25.0%	3	8.5%	8.5%

Number of comparisons = 10

Consistency ratio (CR) = 7.3%

Table 7 presents the results of prioritizing the five previously established criteria, with a CR of 7.3%. The test results indicate that strength is the top priority at 35.1%, followed by speed as the second priority at 28.5%. Endurance ranks third at 25.0%, flexibility is fourth at 6.0%, and agility is fifth at 5.5%. This indicates that strength is the top priority in the talent selection process for junior soccer athletes, followed by speed in the second position, endurance in the third, flexibility in the fourth, and agility in the fifth. Next, the authors present the results of the weight calculations derived from the main eigenvector of the decision matrix for the criteria, as shown in Table 8.

Table 8. Results of the physique sub-criteria decision matrix

	Flexibility	Speed	Agility	Strength	Endurance
Flexibility	1	0.12	1.00	0.12	0.20
Speed	8.00	1	6.00	0.50	1.00
Agility	1.00	0.12	1	0.25	0.17
Strength	8.00	2.00	4.00	1	1.00
Endurance	2.00	1.00	6.00	1.00	1

Principal eigenvalue = 5.329 Eigenvector solution: 5 iterations, delta = 7.9E-8

Table 8 shows the results of the selection criteria decision matrix, with a principal eigenvalue of 5.329. Based on Table 8, the weight calculation results are as follows: between flexibility and speed is 0.12; between flexibility and agility is 1.00; between flexibility and strength is 0.12; between flexibility and endurance is 0.20; between speed and flexibility is 8.00; between speed and agility is 6.00; between speed and strength is 0.50; between speed and endurance is 1.00; between agility and flexibility is 1.00; between agility and speed is 0.12; between agility and strength is 0.25; between agility and endurance is 0.17; between strength and flexibility is 8.00; between strength and speed is 2.00; between strength and agility is 4.00; between strength and endurance is 1.00; between endurance and flexibility is 2.00; between endurance and speed is 1.00; between endurance and agility is 6.00; and between endurance and strength is 1.00. Next, the authors present the results of prioritizing the technical sub-criteria, as shown in Table 9.

Table 9. Results of determining technical sub-criteria

Sub-criteria	Priority	Rank	(+)	(-)
Kicking	22.4%	4	3.2%	3.2%
Dribbling	23.3%	3	1.6%	1.6%
Shooting	25.9%	1	4.9%	4.9%
Stopping	4.3%	5	0.9%	0.9%
Passing	24.1%	2	1.6%	1.6%

Number of comparisons = 10

Consistency ratio (CR) = 0.9%

Table 9 shows the results of prioritizing the five established criteria, with a consistency ratio (CR) of 0.9%. The test results indicate that shooting is the top priority at 25.9%, followed by passing in second place at 24.1%, dribbling in third at 23.3%, kicking in fourth at 22.4%, and stopping in fifth at 4.3%. This demonstrates that shooting is the foremost criterion in the talent selection process for junior football athletes, followed by passing, dribbling, kicking, and stopping. Next, the authors present the results of the weight calculations derived from the main eigenvector of the decision matrix for the criteria, as shown in Table 10.

Table 10. Results of the technical sub-criteria decision matrix

	Kicking	Dribbling	Shooting	Stopping	Passing
Kicking	1	1.00	1.00	4.00	1.00
Dribbling	1.00	1	1.00	5.00	1.00
Shooting	1.00	1.00	1	8.00	1.00
Stopping	0.20	0.20	0.12	1	0.17
Passing	1.00	1.00	1.00	6.00	1

Principal eigenvalue = 5.042

Eigenvector solution: 4 iterations, delta = 9.1E-10

Table 10 shows the results of the selection criteria decision matrix, with a principal eigenvalue of 5.042. Based on Table 10, the weight calculation results are as follows: between kicking and dribbling is 1.00; between kicking and shooting is 1.00; between kicking and stopping is 4.00; between kicking and passing is 1.00; between dribbling and kicking is 1.00; between dribbling and shooting is 1.00; between dribbling and stopping is 5.00; between dribbling and passing is 1.00; between shooting and kicking is 1.00; between shooting and dribbling is 1.00; between shooting and stopping is 8.00; between shooting and passing is 1.00; between stopping and kicking is 0.20; between stopping and dribbling is 0.20; between stopping and shooting is 0.12; between stopping and passing is 0.17; between passing and kicking is 1.00; between passing and dribbling is 1.00; between passing and shooting is 1.00; and between passing and stopping is 6.00.

Discussion

The process of calculating talent identification results for football athletes who meet specific criteria involves thorough and detailed data analyses. It starts with the collection of information through physical tests and techniques designed to assess various aspects of an athlete's abilities. Each test result is analyzed and compared against established standard criteria based on research and best practices in football. These calculations enable coaches and management teams to evaluate whether an athlete possesses the necessary attributes to succeed in a competitive environment. Thus, these accurate and systematic calculations serve as the foundation for selecting, developing, and placing players in suitable positions, as well as for planning effective training programs to maximize both individual and team potential.

In selecting soccer players, physical ability receives the highest weight according to the AHP method. Aspects such as muscle strength, endurance, speed, and agility are crucial because they directly impact a player's performance on the field (Nurjaya et al., 2020; Ötting & Karlis, 2023; Patel et al., 2019; Pranata, 2021; Putri & Nugroho, 2022; Schulze et al., 2018). Players with strong physical strength can endure intense games longer, execute fast sprints, and maneuver nimbly to evade opponents. Flexibility plays a crucial role in reducing injury risk and providing a greater range of motion. An individual's physical condition is considerably influenced by his/her daily activity levels and lifestyle choices. (Liu et al., 2014). Good physical condition will support your soccer-playing skills. To achieve good physical condition, it is necessary to carry out structured and planned training to improve the athlete's physical condition (Annisa, 2015; Saripah & Rusdiana, 2023).

In addition to flexibility, anthropometric factors, or body measurements, are crucial when selecting soccer players using the AHP method, even though they often weigh less than their physical abilities. Height, weight, and body composition (muscle and fat percentages) are evaluated because they affect a player's performance in physical confrontations, endurance, and movement efficiency. Players with optimal height and balanced body proportions typically excel in aerial contests and one-on-one battles. Those who are tall and have a rounder physique tend to be less agile compared to individuals with a medium build who are slightly shorter but possess strong muscles. This dynamic can also influence a player's technique in soccer.

Football playing techniques are also heavily weighted in the AHP analysis. Fundamental technical skills, including kicking, dribbling, passing, shooting, and stopping the ball, are essential because they directly influence the quality of a player's performance. Among these, shooting technique ranks as the top priority in the technical sub-criteria (Sarmiento et al., 2014; Trajkov, 2020; Winata, 2022). Players with strong technical skills can effectively control the game, create opportunities, and execute strategies. Consistent practice of techniques and regular skill evaluations are essential for improving performance and addressing any deficiencies.

Thus, using the AHP for establishing the criteria used in final decision-making and using predefined comparison scale values is highly beneficial in the talent selection process for football athletes. AHP effectively synthesizes the priorities derived from each pairwise comparison matrix, resulting in a global scale of priorities that ranks proposed alternatives based on all established criteria (Melese et al., 2020). This helps coaches and sports administrators determine the assessment weight for each criterion and sub-criterion when selecting talent among football athletes. Additionally, this study demonstrates that individual subjectivity carries less weight, thereby minimizing the potential for conflicts of interest in the talent selection process among junior football athletes.

The AHP facilitates the decision-making process for coaches or testers by eliminating athletes who do not meet the established criteria. Athletes who do meet the criteria will advance through the selection process and receive a training program to prepare for the next stage (Mujito et al., 2018). This creates considerable opportunities for specific sports to identify and recruit promising athletes owing to the consistency offered by an application-based system. Consistent with previous studies in different sports, the AHP is recognized as an effective method for identifying and selecting athletic talent (Kay & Kucera, 2018).

Conclusions

Based on the research findings, the authors conclude that AHP is the most suitable method for establishing priorities in talent selection among junior football athletes. The AHP method identifies 14 sub-criteria grouped into 3 main criteria, with physicality being the top priority in the talent selection process. The application of AHP is appropriate for athlete selection owing to its clear stages and high level of objectivity. AHP effectively established a robust hierarchical structure for evaluating alternatives against relevant criteria. Furthermore, this method enhances transparency in decision-making, enabling stakeholders to better understand and assess the process. Thus, the authors recommend applying the AHP method in the talent selection process for athletes in other sports to achieve results with a high level of objectivity.

Conflicts of interest

The authors declare that there are no conflicts of interest in this article.

Acknowledgements

The authors would like to thank the Study Program of Sport Physical Coaching, Faculty of Sport and Health Education, Universitas Pendidikan Indonesia that have supported the research conducted and until the publication of the article.

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