SPORT TK-EuroAmerican Journal of Sport Sciences

https://revistas.um.es/sportk Online ISSN: 2340-8812

Received: **05/07/2025.** Accepted: **08/11/2025.** Published: **03/04/2026**

Comparison of decision-making skills among female football players from U-12 to professional age groups

Guilherme Machado[1*], Alba Práxedes[2], Sixto González-Víllora[3], Israel Teoldo[4]

[1] Centre of Research and Studies in Soccer, Universidade Federal de Viçosa, Brazil / Department of Athletes' Integration and Development, Paulista Football Federation (FPF), São Paulo, Brazil.

[2] University of Rey Juan Carlos, Spain.

[3] EDAF Research Group, Faculty of Education, University of Castilla-La Mancha (UCLM), Albacete, Spain.

[4] Centre of Research and Studies in Soccer (NUPEF), Physical Education Department, Universidade Federal de Viçosa (UFV), Viçosa-MG, Brazil.

* Correspondence: Guilherme Machado; machado.guilhermef@gmail.com

ABSTRACT

The aim of this study was to compare the decision-making skills of female football players of different age groups (U-12, U-14, U-16, U-18 and Professional). For this purpose, the decision-making quality and the decision-making time were measured based on the core tactical principles of the offensive and defensive phases. The sample comprised a total of 63 Spanish female football players from U-12 (n=12), U-14 (n=9), U-16 (n=15), U-18 (n=12), and professional (n=15) age groups participating in national and regional competitions for their age group. The TacticUP® platform was used to assess the decision-making skills (quality and time). The results showed no significant differences in decision-making quality ($p>0.05$), whereas significant differences in decision-making time were found between age groups in both offensive and defensive phases ($p< 0.05$). Specifically, professional players made significantly ($p<0.05$) quicker decisions compared to U-16 and U-12 players. Therefore, it is concluded that Spanish female football players' decision-making skills differ between professional and youth players, although such differences are not linear.

KEYWORDS

Tactical Awareness; Perceptual-Cognitive Skills; Talent Development; Soccer; Women

1. INTRODUCTION

Talent development and the attainment of superior performance in football depends on different skills developed by players throughout their sport pathway, such as technical, physical, psychological, and tactical skills (Williams et al., 2020). Among these attributes, we highlight the importance of football players' ability to make efficient and quick decisions since this topic has attained even greater relevance due to changes in the dynamics of the sport (Teixeira et al., 2025). Research demonstrated that over the period from 1966 to 2010, game speed increased by 15%, and player density around the ball increased significantly with a 35% greater passing rate (Wallace & Norton, 2014). These changes demand quicker decision-making and higher precision from players due to the increased congestion and reduced time and space available (Paucar-Uribe et al., 2025). Therefore, it is increasingly important to enhance this aspect of performance in football players to allow them to timely respond adequately to the game situations requiring quick tactical decisions (Teoldo et al., 2023).

In this regard, decision-making can be defined as the ability of the performer to select and execute an appropriate action in a given situation (Machado & Teoldo, 2020; Williams et al., 2011). In recent years, the study of decision-making related to perceptual-cognitive skills has gained attention, with Cardoso et al. (2019) demonstrating that faster decision-makers use more efficient visual search strategies and less cognitive effort, and Gonçalves et al. (2020) showing that better peripheral perception enhances tactical behavior, particularly in offensive phases. These findings highlight the importance of both central and peripheral vision in enhancing decision-making efficiency in football. However, most studies have focused on male samples, and little is known about the development of decision-making skills in female soccer players (Machado et al., 2022).

Research carried out in the area of talent identification and development has shown that the abilities of perceptual-cognitive decision-making skills in offensive and defensive situations are essential factors for players to be selected for training programs and to continue their sport's development in football (Cardoso et al., 2019, 2020; Hartigh et al., 2018; Roca et al., 2012). A study found that U-11 young male football players (age 10.9 ± 0.43 years) selected to continue in a talent development program possessed better game reading skills in offensive situations than non-selected players (Hartigh et al., 2018). The selected players could better structure and integrate information from the game (e.g., teammates, opponents, and the field of play) (Hartigh et al., 2018) by verbalizing their observations while watching video-based game simulations. In line with these findings, the study conducted by Cardoso et al. (2020) showed that elite male youth football players

(age 16.7 ± 3.1 years) who possessed faster perceptual-cognitive decision-making skills, when compared to their less fast peers, possessed: i) better game reading ability in offensive situations, by using more efficient visual search strategies; ii) and showed a less cognitive effort to make decisions. These skills were assessed through video-based simulations of offensive situations and eye-tracking technology. Moreover, a study carried out by Roca et al. (2012) showed that adult male semi-professional football players (age 20.7 ± 2.4 years) possessed better perceptual-cognitive decision-making skills in defensive situations compared to recreational-level players (age 22.1 ± 2.8 years). These skills were assessed using life-size video simulations of 11v11 soccer situations filmed from the perspective of a central defender.

The three studies presented above primarily focused on male soccer samples. This aligns with recent bibliometric findings that confirm a low percentage of studies on women's soccer within the decision-making research area (Uribe et al., 2025). Although some emerging research links higher decision-making skills in professional Brazilian female players to greater engagement in practice (Machado et al., 2022), a comprehensive understanding of the developmental process across different age groups in female football remains limited (Barquero-Ruiz et al., 2020; Curran et al., 2019; Machado et al., 2020; Roca et al., 2012). This highlights a critical gap, especially considering that soccer played by women and men has differential characteristics (O'Brien-Smith et al., 2020), and sport science researchers should study both.

Considering the results presented above as a whole, it is observed that decision-making skills play an essential role throughout the sport's development process of football players, from childhood (approximately ten years) and adolescence until adulthood (approximately 24 years), and it can be developed through participation on different types of activities (Machado et al. 2020; Roca et al., 2012). However, despite the importance and complementarity of these abilities (offensive and defensive skills) for sports development, there is still a need for a greater understanding of its development throughout sport formation in female players (Machado & Teoldo, 2020).

For instance, after analyzing recent reviews and meta-analyses on this topic (Gledhill et al., 2017; Ivarsson et al., 2020; Murr et al., 2018; Sarmento et al., 2018; Williams et al., 2020), we found that research on talent development and selection in football has mainly focused on the assessment of decision-making accuracy, in situations which only involved the player in possession during attacking plays. It represents a severe limitation on this research topic as empirical evidence has already shown that: 1) during matches, players spend between 97% and 99% of the time performing movements without the ball, either in attack or defense (Di Salvo et al., 2007); and 2) it is important

to develop the ability to make quick decisions for achieving sport expertise (Mann et al., 2007). We highlight that we have not found any research addressing decision-making skills in situations without the ball, and only one study assessed decision time on talent selection, although it was conducted with male participants (Bennett et al., 2020). Therefore, those aspects must be addressed to provide a deeper understanding of how decision-making skills impact talent development and selection.

Another limitation found in research about the development of decision-making skills in football players, as we have already mentioned throughout this introduction, is its focus mainly on male samples (Curran et al., 2019; Machado et al., 2020; Roca et al., 2012).

To the best of our knowledge, we found no research that evaluated the process of decision-making development in female football players, considering the assessment of both offensive and defensive aspects (Barquero-Ruiz et al., 2020). While systematic reviews on decision-making training in youth team sports have included research with female participants (1 out of 6), although it was in volleyball, the overall representation of female samples remains extremely limited within the literature. Consequently, a comprehensive understanding of the developmental process of decision-making skills in female football players, considering both offensive and defensive aspects across different age categories, remains largely unexplored. To give a picture of such discrepancy, a recent systematic review and meta-analysis on psychological factors associated with future performance in football (Ivarsson et al., 2020) found that male samples were more than 100 times overrepresented in studies in this research area.

These limitations highlight the need for research that can subsidize the construction of a structured curriculum that drives the development of decision-making skills throughout sports development education and the talent development pathway of female football players (Curran et al., 2019). For that, it is necessary to understand how decision-making skills change across different age categories. Thus, the main purpose of this study is to compare the decision-making skills of female football players of different age groups (U-12, U-14, U-16, U-18 and Professional). For this purpose, the decision-making quality and the decision-making time were measured based on the core tactical principles of the offensive and defensive phases (Teoldo et al., 2022).

2. METHODS

2.1. Participants

The sample comprised a total of 63 Spanish elite female football players from U-12 (n = 12; age = 11.5 ± 0.6 y/o), U-14 (n = 9; age = 13.2 ± 0.4 y/o), U-16 (n = 15; age = 15.1 ± 0.4 y/o), U-18 (n

= 12; age = 17.2 ± 0.5 y/o) and professional (n = 15; age = 21.3 ± 3.4 y/o) age groups. Players should be participating in national and regional competitions during the first semester of 2022 for their age group for inclusion criteria. Female players from the U-12, U-14, U-18, and professional groups played for the A team (national competition), which in Spain means that such teams are composed of the best players of their age groups, while the U-16 players played for the B team (regional competition). Any player who could not participate in the assessment activity during testing were excluded from the study (n = 6). All players were evaluated in the middle of the competition season (around February). Data were collected with approval from club officials and players' legal guardians. The present study was approved by the Ethics Committee for Research with Human Beings from the Federal University of Viçosa (Approval number: 4.924.597) and is in accordance with the norms established by the Declaration of Helsinki (2013) for research with human beings. Participants and their legal guardians provided signed and informed consent. The sample size was estimated (total n = 60) using the software G*Power version 3.1.9.6 considering a significance level of p = 0.05, power of 0.8 and high effect size (F = 0.45) for the one-way ANOVA test for five groups.

2.2. Measurements

Decision-making quality was defined as the ability of the performer to select an appropriate action in a specific situation (Roca et al., 2012; Williams et al., 2011). Decision-making time was defined as an objective measure of the elapsed time between stimulus onset and the overt production of a response (Mann et al., 2007). In this context, response time and decision-making time refer to the same variable, as both measure the duration between the initial stimulus and the selection or execution of an appropriate response.

In addition, both variables (decision-making quality and time) were analysed based on the core tactical principles of the offensive and defensive phases and regarding the playing space (inside or outside the center of play) (Machado & Teoldo, 2020, Teoldo et al., 2022). Core tactical principles represent a set of ground rules that guide players' and team's actions in both phases of play (defence and attack), in order to create unbalances in the opponent's organization, stabilize the organization of the team and provide players with an adjusted intervention within the "center of play" (Teoldo et al., 2009). The center of play is a circumference of 9.15 m radius from the location of the ball. It was conceived based on the official laws of football, as it is assumed that players located farther than 9.15 m from the player in possession of the ball cannot interfere directly in his actions (Teoldo et al., 2022). This categorization of the core tactical principles can be seen in Table 1.

Table 1. Description of the core tactical principles of football (Teoldo et al., 2022) regarding the phase of game and the role of the player

PHASE		Tactical Principles
Offensive phase	Offensive phase inside the center of play	*Penetration* Action to advance with the ball to the opponent´s goal line, that is, to decrease the distance between the player in possession of the ball and the opponent´s goal.
		Width and length with the ball Movements of the player in possession of the ball towards the own team´s goal line or either touch line, in order to gain space and time for a better subsequent action.
		Offensive coverage Actions of approaching or distancing of the player in possession of the ball, to ensure safe passing lines/zones and increase the speed and rhythm of play (inside the center of play).
	Offensive phase outside the center of play	*Width and length without the ball* Movements of the players without the ball performance ahead of the line of the ball (outside the center of play), in order to allow longer and deep passes.
		Depth Mobility Movements performed by the players without the ball behind the back of the last line of defenders.
		Offensive unity Action of organization of the attacking lines in order to maintain teams unity and allow a more collective play.
Defensive phase	Defensive phase inside the center of play	*Delay* Actions to delay the player in possession of the ball to move towards the goal.
		Defensive coverage Actions to ensure support to the first defender who is performing delay to the player in possession of the ball.
		Recovery balance Movements of defensive players performed in the less offensive half of the center of play to increase pressure on the player in possession of the ball, in order to recover the ball or reduce passing lines behind the ball line.
	Defensive phase outside the center of play	*Defensive balance* Movements performed in zones of play to ensure defensive stability for the teams (allow better defensive balance).
		Concentration Movements of the defensive players performed to increase protection of the goal and force the opponent´s attacking actions towards the sides of the field.
		Defensive unity Actions to ensure the organization of the defensive lines to allow the team to defend as a unity or block and obtain more defensive protection.

2.2. Data Collection and Procedures

The decision-making skills (quality and time) were assessed in each game phase (attack and defense) using the TacticUP® video test for football (Machado & Teoldo, 2020). The TacticUP® test has demonstrated adequate validity and reliability (Machado & Teoldo, 2020), with additional validation performed using female samples (Machado et al., 2023b). Furthermore, several studies on decision-making have employed this test (Barcellos et al., 2022; Dambroz & Teoldo, 2023; de Oliveira et al., 2024; Machado et al., 2020; Machado et al., 2023b; Sun et al., 2022; Teoldo et al., 2023). The TacticUP® test (www.tacticup.com.br) is composed of offensive and defensive video sequences (scenes) of 11 versus 11 football situations. Participants had to choose the most appropriate solution for each scene from four possible solutions (i.e., make decisions). Each scene lasted between 5s and 7s.

The variables measured by the TacticUP® were grouped in some categories as done in previous studies (Andrade et al., 2021; Barcellos et al., 2020; Machado et al., 2023a, 2023b; Machado et. al., 2024). Those categories are: 1) offensive phase inside the centre of play - principles of penetration, offensive coverage and width and length with the ball; 2) offensive phase outside the centre of play – principles of width and length without the ball, mobility and offensive unity; 3) offensive phase – all the offensive principles; 4) defensive phase inside the centre of play – principles of delay, defensive coverage and recovery balance; 5) defensive phase outside the centre of play – principles of defensive balance, concentration and defensive unity; 6) defensive phase – all the defensive principles; and 7) game – all the offensive and defensive principles. This categorisation was performed due to the phases of the game (attack and defence) and the spatial relations between these principles and the centre of play, as well as their hierarchical relationships within the teaching-learning process. The tactical principles performed inside the centre of play display less complexity regarding their execution when compared to those performed outside the centre of play (Machado & Teoldo, 2020; Teoldo et al., 2022).

Before starting the test, the online platform displays instructions to participants regarding the test structure and procedures. Then, three trial scenes are exhibited to familiarize the subjects with the assessment, thus excluding the possibility of low performance due to a lack of comprehension of the task. These three trial scenes include two offensive sequences (one in which the player being observed has the ball and another in which he is not in possession) and one defensive sequence (the player being observed is in the defensive phase of play). These three conditions enable participants to familiarize themselves with the characteristics of the video sequences they were about to watch.

After that, each participant performed the test (see Figure 1), which included 36 scenes during between 5-7 seconds, which took around 20 minutes for each. The test was carried out in a quiet room using iPads (iOS 12.4.5) with internet access to perform the test in the TacticUP® platform. Finally, the final scores given by the TacticUP® are presented in 15 items (one for each core tactical principle), plus scores for the offensive phase, defensive phase, and game (offensive and defensive phases altogether) (Machado & Teoldo, 2020). The decision-making quality is presented in scores (% of accuracy and precision) that varies between 0 to 100 points for each variable. The decision-making time is presented in seconds, and it is calculated between the time the player finishes watching a scene and chooses the response for that scene. The TacticUP® online platform automatically calculates both decision-making quality and decision-making time.

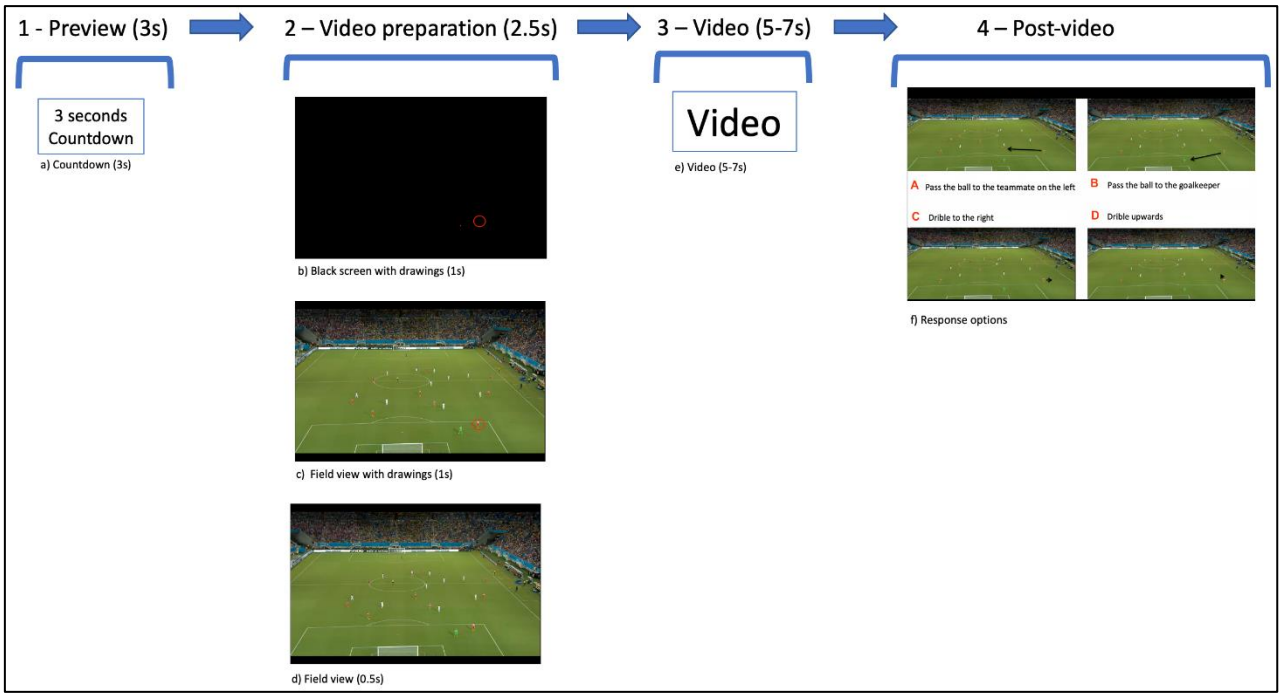

Figure 1. Order of presentation of the scenes

2.4. Statistical Analysis

Outcomes of quality of decision-making and decision-making time are presented as means and standard deviations. Data distribution was checked with a Kolmogorov-Smirnov test. Considering the data distribution, we verified the between-group differences using a one-way ANOVA followed by Bonferroni post-hoc for pairwise comparisons. The effect size was calculated through the values of eta-squared ($\eta 2$) (Fritz et al., 2012). The magnitudes of $\eta 2$ were interpreted according to the following classification: large effect (> 0.14), moderate effect (from 0.06 to 0.14),

and small effect (< 0.01) (Cohen, 1988). For statistical procedures was utilized the software SPSS 22 (Statistical Package for Social Sciences).

3. RESULTS

The descriptive and inferential analysis between age categories in each game phase is presented in Table 2 and Table 3. Additionally, the effect size was calculated, and pairwise comparisons were conducted for the five categories for each dependent variable (decision-making quality and decision-making time). Table 2 shows how good decision-making is on average in different groups, and how much the results differ within each group.

Table 2. Means and standard deviations of the quality of decision-making for each category

	U-12 (n = 12)	U-14 (n = 9)	U-16 (n = 15)	U-18 (n = 12)	Professional (n = 15)	p value	Effect Size
Offensive							
Off. Phase	67.8 ± 9.8	66.5 ± 9.2	67.2 ± 7.4	66.8 ± 9.6	71.3 ± 6.9	.577	-
Off. Inside	71.8 ± 10.1	69.2 ± 13.8	74.1 ± 10.2	74.8 ± 13.1	79.3 ± 8.1	.236	-
Off. Outside	63.8 ± 16.5	63.8 ± 11.6	60.2 ± 7.9	58.8 ± 10.6	63.3 ± 10.0	.727	-
Defensive							
Def. Phase	61.1 ± 9.7	58.5 ± 12.2	64.4 ± 9.6	65.3 ± 5.8	63.7 ± 7.0	.398	-
Def. Inside	58.7 ± 12.3	55.0 ± 9.4	62.4 ± 10.5	62.4 ± 12.2	60.7 ± 10.9	.515	-
Def. Outside	61.4 ± 12.0	62.6 ± 13.6	65.0 ± 14.9	64.8 ± 11.2	59.9 ± 6.4	.748	-
Game							
Game	64.5 ± 6.4	62.5 ± 7.5	65.8 ± 6.5	66.1 ± 6.0	67.5 ± 5.2	.410	-

***Note**. Off Phase: Offensive Phase; Off. Inside: Offensive phase inside the center of play; Off. Outside: Offensive phase outside the center of play; Def Phase: Defensive Phase; Def. Inside: Defensive phase inside the center of play; Def. Outside: Defensive phase outside the center of play.*

Based on the table above, results revealed no significant differences between age categories ($p>0.05$). On the contrary, regarding the decision-making time, results revealed significant differences between age categories in all game phases ($p<0.05$, see Table 3).

Table 3. Means and standard deviations of the time of decision-making for each category

	U-12 (n = 12)	U-14 (n = 9)	U-16 (n = 15)	U-18 (n = 12)	Professional (n = 15)	p value	Effect Size
Offensive							
Off. Phase	12.0 ± 4.4	9.9 ± 6.1	12.4 ± 8.2	9.2 ± 1.7	6.2 ± 2.3	.015[1]	0.188
Off. Inside	12.4 ± 3.7	9.7 ± 5.3	14.2 ± 11.7	9.1 ± 1.8	6.8 ± 2.8	.032[1]	0.164
Off. Outside	11.6 ± 5.4	10.2 ± 7.1	10.6 ± 6.4	9.2 ± 2.4	5.6 ± 2.3	.024[2]	0.174
Defensive							
Def. Phase	13.6 ± 4.1	10.3 ± 6.4	13.3 ± 8.1	10.0 ± 2.3	6.4 ± 1.8	.003[1,2]	0.240
Def. Inside	13.3 ± 5.6	9.9 ± 6.3	12.6 ± 7.4	9.9 ± 3.0	6.6 ± 1.9	.010[1,2]	0.201
Def. Outside	13.7 ± 4.7	8.6 ± 4.0	13.8 ± 9.4	10.0 ± 2.6	7.0 ± 2.2	.005[1,2]	0.223
Game							
Game	12.8 ± 4.0	10.1 ± 5.9	12.8 ± 8.1	9.6 ± 1.7	6.3 ± 2.0	.005[1,2]	0.223

***Note**. Off Phase: Offensive Phase; Off. Inside: Offensive phase inside the center of play; Off. Outside: Offensive phase outside the center of play; Def Phase: Defensive Phase; Def. Inside: Defensive phase inside the center of play; Def. Outside: Defensive phase outside the center of play*. Pairwise Comparisons: [1]U-16 vs Professional: [2]U-12 vs Professional.

According to the offensive phases, professional players made quicker decisions when compared to U-16 players for the offensive phase (p=.015, large effect) and for the offensive phase inside the center of play (p=.032, large effect), and quicker decisions when compared to U-12 players, for the offensive phase outside the center of play (p=.024, large effect).

According to the defensive phases, as in the offensive phase, professional players made quicker decisions compared to U-16 and U-12. However, these results show significant differences concerning both age categories in all phases (p=.003, large effect; p=.010, large effect; p=.005, large effect). Finally, and according to the game phase, again professional players made quicker decisions when compared to U-16 and U-12 (p=.005, large effect).

4. DISCUSSION

The main purpose of this study was to compare the decision-making skills of female football players of different age groups (U-12, U-14, U-16, U-18 and Professional). For this purpose, the decision-making quality, related to the appropriateness of an action in a given situation, and the decision-making time, which is the time between stimulus onset and the overt production of a response, were measured based on the core tactical principles of the offensive and defensive phases (Teoldo et al., 2022). In general, while in the decision-making quality were not found significant differences, in the decision-making time, such differences were found among female categories. Thus, the decision time element seems to position itself as an essential element for players to have a high level of expertise and to be able to play soccer at a high level.

Literature indicates that unstructured practice (non-organized, peer-led sporting play or also known as deliberate play) and the micro-structure or structured practice (organized, teacher-led practice or also known as deliberate practice) contribute to the development of decision-making skills (Machado et al. 2020; Roca et al., 2012). Additionally, after childhood (6-12 years of age), deliberate practice starts to assume greater importance in the sport's development in football compared to deliberate play (Côté et al., 2007; Ford & Williams, 2012). Due to that, the amount of deliberate practice (which is what we can "measure" through the federative categories) gains even more importance for the athletes' development (Ward et al., 2007). In this way, it is highlighted the need to evaluate during the whole process of sport’s development in football, the contribution of deliberate

practice for both offensive and defensive decision-making skills, which are complementary components of players' ability (Cardoso et al., 2019, 2020; González-Víllora et al., 2015).

In relation to the decision-making quality, as pointed out before, results showed no significant differences ($p>0.05$) between age categories in none of the phases studied (offensive and defensive). Among the reasons that might explain such results, we highlight that although we have not controlled this information in our study, is that the training focus during the formative stages of female football players in Spain might not be directed toward developing the quality of decision-making skills (González-Víllora, 2025; Machado et al., 2024). On the contrary, it might be more directed to other performance dimensions, such as technical and physical aspects, similar to data found in recent research with female German players (Güllich, 2019). Although recent studies carried out by Roca & Ford (2020) with male football players in Spain suggest that elite Spanish clubs focus their training on the development of decision-making skills compared to other European countries, such as Germany and the United Kingdom, we found no data that support this same trend on female football. Therefore, it could be interesting for future studies to investigate the structure of football development in Spain with female players to provide a greater understanding of this topic.

A study conducted by González-Víllora et al. (2015) with Spanish youth male football players found a different pattern in the development of the quality of perceptual-motor decision-making skills assessed with a field-based test among U-8, U-10, U-12, and U-14 age groups. In addition, it found differences in offensive and defensive tactical principles between the four age groups, with an advantage for older players compared to their younger peers. These differences from our results might be related to the differences in the development of decision-making skills among males and females but also due to the different assessment methods employed. On the other hand, considering professional female football, a study conducted with 77 professional elite Brazilian players found a similar value for the quality of decision-making skills in the "Game" (67.2 on average) assessed with the same instrument used in our study (i.e., TacticUP®) (Machado et al., 2022). It indicates that Spanish and Brazilian professional female football players possess similar overall decision-making skills (Brazilian 67.2 and Spanish 67.5). Future studies could investigate differences in more specific skills (e.g., offensive and defensive decision-making skills), considering different countries and cultures to provide a more comprehensive picture of how culture may influence such skills, trough analysis of elite clubs or even national teams in the different categories.

Concerning the decision-making time, professional players made quicker decisions than U-12 players in almost all phases (offensive and defensive). These findings indicate that the structured

practice (organised, coach-led practice or also known as deliberated practice) (Côté et al., 2007), developed during adolescence, has positively affected decision-making time. This result is supported by a recent study carried out with elite professional female football players in Brazil, showing that speed of decision-making skill is related to the accumulation of team practice during late adolescence (16-18 years old) (Machado et al., 2022). In other words, those players who accumulated more practice time during late adolescence were quicker decision-makers than those who accumulated less time in practice. These results altogether suggest that team practice during late adolescence plays an important role in the development of decision-making time in female football players, considering different cultural contexts, such as Brazil and Spain.

However, these differences in decision-making time were not found in the offensive phase outside the center of the play. The decision on such a category of principles is related to movements performed far from the ball (e.g., creating passing lanes in the last defensive line of the opponent) (Teoldo et al., 2022). Therefore, as players have more time to decide when they are far away from the ball compared to when they are close to it (Güllich, 2019). Thus, as the time needed to make decisions could be longer in such situations might not be as decisive for their performance as it is for principles performed inside the center of play. Thus, the game demand to make quicker decisions in situations near the ball probably led to team practice that develops this skill in such situations, but not in situations far from the ball (Güllich, 2019; Machado et al., 2020).

Results also showed significant differences between professional players and U-16 players ($p<0.05$). In this regard, it is necessary to indicate that the time to make a decision in U-16 players is higher or similar than in U-14 and U-12 players (i.e., while professionals make quicker decisions than U-16, these players make slower or similar decisions than U-14 and U-12). These results break the tendency to improve throughout the age categories. One possible explanation for the differences found in the U-16 category is that in the other age categories, participants belong to team A, whereas in the U-16 category, players were from team B. In Spain, football players are distributed according to their expertise and sport expertise level. Thus, while A teams in each category consisted of players who had been selected with performance objectives, B teams consisted of players who were not selected among the best of their category. In this regard, both Gutiérrez Díaz et al. (2010); Romann & Fuchslocher (2011) pointed out that players who are selected by the best teams of each category (teams A) benefit from a more significant number of training hours. In this sense, the experience they accumulate usually is greater than that of the other players, providing them with advantages in achieving peak performance (Ward & Williams, 2003). On the other hand, players from team B do

not have the advantage of being trained by the best coaches and participating in the highest-level competitions (Figueiredo et al., 2009).

In summary, given the limited research in this area, continued investigation into the development of decision-making skills in female football across different age groups and competitive levels is essential. To advance this field, future studies should employ longitudinal designs to track players over time and gain insights into developmental trajectories. Furthermore, it is crucial to identify and investigate the specific factors that determine the observed differences in decision-making. In particular, future research could explore the type of practice received by female football players, specifically whether the focus is on tactical or technical development, as this could significantly influence decision-making skills. Addressing the limitations of the current study, such as sample size, by including female players from diverse countries and competitive levels will also provide a deeper understanding of how age, culture, and competitive level moderate these skills.

5. CONCLUSIONS

It is concluded that Spanish female football players' decision-making skills are different compared to professional and youth football players, although such differences are not linear. In other words, it means that we did not observe an increment for each category as they were getting older (e.g., the U-16 age group showed similar decision-making time than U-12 age group). Moreover, the competitive level of players apparently impacts in their decision-making skills, as we found a similar decision-making time for U-12 players competing in national level and U-16 players competing in regional level. The most obvious finding to emerge from this study is that professional players were quicker decision-makers in offensive and defensive situations than U-16 and U-12 players. However, in terms of the quality of decision-making skills, no significant differences were found among the age groups assessed. Finally, due to the scarce data on this topic and the sample size of our study, more research is needed in women's football to confirm or refute the trend found by our research.

5.1. Practical Implications

- Enhance decision-making in specific situations: Develop targeted training strategies to improve decision-making time in situations both near and far from the ball, as the speed of decision-making may vary depending on the game scenario.
- Assess players' decision-making skills: Assessment of players' decision-making skills across different age groups can be used to adjust the training focus accordingly to optimize players’

needs.

- Strengthen late adolescence practice: Emphasize structured team practice during ages 16-18, as studies suggest that it positively impacts decision-making speed in female football players across different cultural contexts.

6. REFERENCES

1. Andrade, L., Machado, G., Gonçalves, E., & Teoldo, I. (2021). Decision making in soccer: effect of positional role of U-13 soccer players. *Journal of Physical Education and Sport, 21*(3), 1413–1420. https://doi.org/10.7752/jpes.2021.03180
2. Barcellos, A., Teoldo, I., & Machado, G. (2022). The Influence of 25 Training Sessions on the Decision-Making Skill of U-12 Soccer Players. *Psicologia: Teoria e Pesquisa, 38*, 1-12. https://doi.org/10.1590/0102.3772E38211.EN
3. Barquero-Ruiz, C., Arias-Estero, J. L., & Kirk, D. (2020). Assessment for tactical learning in games: A systematic review. *European Physical Education Review, 26*(4), 827–847. https://doi.org/10.1177/1356336X19889649
4. Bennett, K. J. M., Novak, A. R., Pluss, M. A., Coutts, A. J., & Fransen, J. (2020). A multifactorial comparison of Australian youth soccer players' performance characteristics. *International Journal of Sports Science and Coaching, 15*(1), 17–25. https://doi.org/10.1177/1747954119893174
5. Cardoso, F., González-Víllora, S., Guilherme, J., & Teoldo, I. (2019). Young soccer players with higher tactical knowledge display lower cognitive effort. *Perceptual & Motor Skills, 126*(3), 499–514. https://doi.org/https://doi.org/10.1177/0031512519826437
6. Cardoso, F., Neves, J., Roca, A., & Teoldo, I. (2020). The association between perceptual-cognitive processes and response time in decision making in young soccer players. *Journal of Sports Sciences, 39*(8), 926–935. https://doi.org/10.1080/02640414.2020.1851901
7. Corrêa, U. C., Alegre, F. A. M., Freudenheim, A. M., Dos Santos, S., & Tani, G. (2012). The game of futsal as an adaptive process. *Nonlinear Dynamics, Psychology, and Life Sciences, 16*, 185–204.
8. Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203771587
9. Côté, J., Baker, J., & Abernethy, B. (2007). *Practice and play in the development of sport expertise.* In R. Eklund & G. Tenenbaum (Eds.), Handbook of Sport Psychology (3rd ed., pp. 184–202). John Wiley & Sons.
10. Curran, O., MacNamara, A., & Passmore, D. (2019). What about the girls? Exploring the gender data gap in talent development. *Frontiers in Sports and Active Living, 1*, 1–7. https://doi.org/10.3389/fspor.2019.00003
11. Dambroz, F., & Teoldo, I. (2023). Better decision-making skills support tactical behaviour and reduce physical wear under physical fatigue in soccer. *Frontiers in Physiology, 14*, 1-9. https://doi.org/10.3389/FPHYS.2023.1116924
12. de Oliveira, G. I. S., de Lima, J. A., Vasconcellos, F., da Silva, D. C., & de Moura, E. J. L. (2024). Decision-making of U-17 soccer players according to positional role. *Retos, 54*, 754–760. https://doi.org/10.47197/RETOS.V54.103213
13. Di Salvo, V., Baron, R., Tschan, H., Calderon-Montero, F. J., Bachl, N., & Pigozzi, F. (2007). Performance characteristics according to playing position in elite soccer. *International Journal of Sports Medicine, 28*, 222–227. https://doi.org/10.1055/s-2006-924294

14. Faber, J., & Fonseca, L. M. (2014). How sample size influences research outcomes. *Dental Press Journal of Orthodontics, 19*(4), 27–29. https://doi.org/10.1590/2176-9451.19.4.027-029.ebo
15. Figueiredo, A. J., Gonçalves, C. E., Coelho E Silva, M. J., & Malina, R. M. (2009). Youth soccer players, 11-14 years: maturity, size, function, skill and goal orientation. *Annals of Human Biology, 36*(1), 60–73. https://doi.org/10.1080/03014460802570584
16. Ford, P. R. & Williams, A. (2012). The developmental activities engaged in by elite youth soccer players who progressed to professional status compared to those who did not. *Psychology of Sport and Exercise, 13,* 349–352. https://doi.org/10.1016/j.psychsport.2011.09.004
17. Fritz, C., Morris, P., & Richler, J. (2012). Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General, 141*(1), 2–18. https://doi.org/10.1037/a0024338
18. Gledhill, A., Harwood, C., & Forsdyke, D. (2017). Psychosocial factors associated with talent development in football: A systematic review. *Psychology of Sport and Exercise, 31,* 93–112. https://doi.org/10.1016/j.psychsport.2017.04.002
19. Gonçalves, E., Noce, F., Barbosa, M. A. M., Figueiredo, A. J., Hackfort, D., & Teoldo, I. (2020). 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), 687–699. https://doi.org/10.1080/1612197X.2017.1329222
20. González-Víllora, S., García-López, L. M., & Contreras-Jordán, O. R. (2015). Decision making and skill development in youth football players. *International Journal of Medicine and Science of Physical Education, 15*(59), 467–487. https://doi.org/10.15366/rimcafd2015.59.005
21. González-Víllora, S., Machado, G., Gualda, A., & Teoldo, I. (2025). The effect of 14 training sessions on the development of decision-making skills in U-13 soccer players. *International Journal of Performance Analysis in Sport, 25*(5), 995-1012. https://doi.org/10.1080/24748668.2025.2481691
22. González-Víllora, S., Serra-Olivares, J., Pastor-Vicedo, J., & Teoldo, I. (2015). Review of the tactical evaluation tools for youth players, assessing the tactics in team sports: football. *Springerplus, 4*(663), 1–17. https://doi.org/https://doi.org/10.1186/s40064-015-1462-0
23. Güllich, A. (2019). "Macro-structure" of developmental participation histories and "micro-structure" of practice of German female world-class and national-class football players. *Journal of Sports Sciences, 37*(12), 1347–1355. https://doi.org/10.1080/02640414.2018.1558744
24. Gutiérrez Díaz, D., Pastor-Vicedo, J. C., González-Víllora, S., Contreras-Jordán, O. R. (2010). The relative age effect in youth soccer players from Spain. *Journal of Sports Sciences and Medicine, 9*(2), 190-198.
25. Hartigh, R., Steen, S., Hakvoort, B., Frencken, W., & Lemmink, K. (2018). Differences in game reading between selected and non-selected youth soccer players. *Journal of Sports Sciences, 36*(4), 422–428. https://doi.org/10.1080/02640414.2017.1313442
26. Ivarsson, A., Kilhage-Persson, A., Martindale, R., Priestley, D., Huijgen, B., Ardern, C., & McCall, A. (2020). Psychological factors and future performance of football players: A systematic review with meta-analysis. *Journal of Science and Medicine in Sport, 23*(4), 415–420. https://doi.org/10.1016/j.jsams.2019.10.021
27. Machado, G., González-Víllora, S., Sarmento, H., & Teoldo, I. (2020). Development of tactical decision-making skills in youth soccer players: Macro- and microstructure of soccer developmental activities as a discriminant of different skill levels. *International Journal of Performance Analysis in Sport, 20*(6), 1072–1091. https://doi.org/10.1080/24748668.2020.1829368
28. Machado, G., González-Víllora, S., Pastor-Vicedo, J., & Teoldo, I. (2024). Mapping talent pathways: A comparative study of developmental activities and practice structure in Brazilian and

Spanish U-18 elite youth male soccer players. *International Journal of Sports Science and Coaching, 19*(5), 2006–2015. https://doi.org/10.1177/17479541241241487

29. Machado, G., González-Víllora, S., & Teoldo, I. (2022). Contribution of deliberate practice, play, and futsal to the acquisition of decision-making skills in Brazilian professional female soccer players. *International Journal of Sport and Exercise Psychology, 22*(3), 756-774.
30. Machado, G, González-Víllora, S., & Teoldo, I. (2023a). Selected soccer players are quicker and better decision-makers in elite Brazilian youth academies. *International Journal of Performance Analysis in Sport, 23*(2), 65–82. https://doi.org/10.1080/24748668.2023.2181609
31. Machado, G, González-Víllora, S., & Teoldo, I. (2023b). The relationship between deliberate practice, play, and futsal in childhood and adolescence and the development of different decision-making skills in professional female soccer players. *Psychology of Sport & Exercise, 68,* 1-10. https://doi.org/10.1016/j.psychsport.2023.102470
32. Machado, G., & Teoldo, I. (2020). TacticUP Video Test for soccer: Development and validation. *Frontiers in Psychology, 11*(1690), 1–12. https://doi.org/10.3389/fpsyg.2020.01690
33. Machado, G., González-Víllora, S., Roca, A., & Teoldo, I. (2024). Developing cognitive and motor decision-making skills through tactical principles and small-sided games in youth soccer. *International Journal of Performance Analysis in Sport, 24*(5), 444-463. https://doi.org/10.1080/24748668.2024.2321039
34. Mann, D. T. Y., Williams, A. M., Ward, P., & Janelle, C. M. (2007). Perceptual-cognitive expertise in sport: A meta-analysis. *Journal of Sport and Exercise Psychology, 29*(4), 457–478. https://doi.org/10.1123/jsep.29.4.457
35. Murr, D., Feichtinger, P., Larkin, P., O'Connor, D., & Höner, O. (2018). Psychological talent predictors in youth soccer: A systematic review of the prognostic relevance of psychomotor, perceptual-cognitive and personality-related factors. *PLoS ONE, 13*(10), 1–24. https://doi.org/10.1371/journal.pone.0205337
36. Paucar-Uribe, J. D., Becerra-Patiño, B. A., Yáñez-Sepúlveda, R., Reyes-Amigo, T., Mello, J. B., Martins, J., Gaya, A. R., López-Gil, J. F., & Olivares-Arancibia, J. (2025). Visualization of the research panorama of decision-making in soccer: Bibliometric analysis with VOSviewer and review of the most cited studies of the last 15 Years (2010–2024). *Sports, 13*(177), 1–24. https://doi.org/10.3390/ sports13060177
37. Roca, A., & Ford, P. R. (2020). Decision-making practice during coaching sessions in elite youth football across European countries. *Science and Medicine in Football, 4*(4), 263–268. https://doi.org/10.1080/24733938.2020.1755051
38. Roca, A., Williams, A. M., & Ford, P. R. (2012). Developmental activities and the acquisition of superior anticipation and decision making in soccer players. *Journal of Sports Sciences, 30*(15), 1643–1652. https://doi.org/10.1080/02640414.2012.701761
39. Romann, M., & Fuchslocher, J. (2011). Influence of the selection level, age and playing position on relative age effects in Swiss Women's soccer. *Talent Develpment and Excellent, 3*(2), 239-247.
40. Sarmento, H., Anguera, M., Pereira, A., & Araújo, D. (2018). Talent identification and development in male football: A systematic review. *Sports Medicine, 48*(4), 907–931. https://doi.org/10.1007/s40279-017-0851-7
41. Sun, H., Soh, K. G., & Xu, X. (2022). Nature Scenes Counter Mental Fatigue-Induced Performance Decrements in Soccer Decision-Making. *Frontiers in Psychology, 13,* 1-12. https://doi.org/10.3389/FPSYG.2022.877844
42. Teixeira, J. E., Maio, E., Afonso, P., Encarnação, S., Machado, G., Morgans, R., Barbosa, T., Monteiro, A., Forte, P., Ferraz, R., & Branquinho, L. (2025). Mapping football tactical behavior and collective dynamics with artificial intelligence: a systematic review. *Frontiers in Sports and Active Living, 7,* 1-23. https://doi.org/10.3389/fspor.2025.1569155

43. Teoldo, Garganta, J., Greco, P., & Mesquita, I. (2009). Tactical Principles of Soccer Game: concepts and application. *Motriz, 15*(3), 657–668. https://doi.org/10.5016/2488
44. Teoldo, I., Guilherme, J., & Garganta, J. (2022). *Football Intelligence: Training and Tactics for Soccer Success.* Routledge.
45. Teoldo, I., Mezzadri, I., Cardoso, F., & Machado, G. (2023). Speed of decision-making as a key element for professional and academy soccer players' performances. *Retos, 50*(4), 1195–1203. https://doi.org/https://doi.org/10.47197/retos.v50.100355
46. Wallace, J. L., & Norton, K. I. (2014). Evolution of World Cup soccer final games 1966-2010: Game structure, speed and play patterns. *Journal of Science and Medicine in Sport, 17*(2), 223–228. https://doi.org/10.1016/j.jsams.2013.03.016
47. Ward, P., Hodges, N., Starkes, J. L., & Williams, A. M. (2007). The road to excellence: deliberate practice and the development of expertise. *High Ability Studies, 18*(2), 119–153. https://doi.org/10.1080/13598130701709715
48. Ward, P., & Williams, A. M. (2003). Perceptual and cognitive skill development in soccer: The multidimensional nature of expert performance. *Journal of Sport Exercise and Psychology, 25,* 93-111.
49. Williams, A. M., Ford, P. R., & Drust, B. (2020). Talent identification and development in soccer since the millennium. *Journal of Sports Sciences, 38*(11–12), 1199–1210. https://doi.org/10.1080/02640414.2020.1766647
50. Williams, A. M., Ford, P. R., Eccles, D. W., & Ward, J. D. (2011). Perceptual-cognitive expertise in sport and its acquisition: Implications for applied cognitive psychology. *Applied Cognitive Psychology, 25*(3), 432–442. https://doi.org/10.1002/acp.1710

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

COPYRIGHT

© Copyright 2026: Publication Service of the University of Murcia, Murcia, Spain.