



Goalkeeper Competitive Level and the Organization of Spanish Futsal Attacks: An Exploratory Observational Study

Bernat Buscà^{1*} , Jordi Arboix-Alió^{1,2} , Biel Buscà¹, Marc Quintana³, Alexis Valera¹ and Joan Aguilera-Castells¹ 

¹ Faculty of Psychology, Education Sciences and Sport Blanquerna, Ramon Llull University, Barcelona (Spain).

² Sport Performance Area, FC Barcelona, Barcelona (Spain).

³ Faculty of Sports Sciences EUSES, Girona University, Girona, (Spain).



Cite this article

Buscà, B., Arboix-Alió, J., Buscà, B., Quintana, M., Valera, A., & Aguilera-Castells, J. (2026). Goalkeeper competitive level and the organization of Spanish futsal attacks: An exploratory observational study. *Apunts. Educación Física y Deportes*, 165, 58-69. <https://doi.org/10.5672/apunts.2014-0983.es.2026.165.06>

Edited by:

© Generalitat de Catalunya
Department of Sports
Institut Nacional d'Educació
Física de Catalunya (INEFC)

ISSN: 2014-0983

*Corresponding author:

Bernat Buscà
bernatbs@blanquerna.url.edu

Section:

Sport Training

Original language:

English

Received:

October 1, 2025

Accepted:

February 24, 2026

Published:

July 1, 2026

Front page:

Artistic swimmers performing a synchronized figure with technical precision and postural control.
© F&W

Abstract

This observational study explored how competitive level relates to the organization of futsal attacking actions involving the goalkeeper in Spain. We analyzed 773 interventions (professional: 529 from the *Liga Nacional de Fútbol Sala*; amateur: 244, from the 2nd and 3rd divisions) from the 2023–2024 season. A Random Forest model classified competitive level with 71.1% accuracy, identifying game moment (e.g., M30), pass type (short vs. long), and action outcome (progression/possession) as key discriminators. Logistic regression indicated that foot receptions and short, precise passes were positively associated with professional status (e.g., M30 coefficient = 0.41; progression = 0.23; possession = 0.19). Principal Component Analysis showed partial separation of profiles, while K-Means yielded two clusters: Cluster 1 contained 66.8% professional players and was characterized by teammate-origin receptions, foot control, and short passes under low pressure; Cluster 0 included 52.9% amateur players, with earlier-phase actions (M10), hand receptions, and bowling passes. Professional goalkeepers exhibited greater adaptability by acting under pressure and facilitating structured build-up, whereas amateur goalkeepers favored conservative, low-risk choices. These findings underscore the goalkeeper's evolving offensive role and offer practical insights for talent identification, tactical training, and performance assessment across competition levels; interpretations are exploratory and bounded by the observational design and league-specific context.

Keywords: competitive standard, logistic regression, match analysis, team sports

Introduction

Although futsal goalkeepers are traditionally the last line of defense, research shows that 67% of their interventions have offensive intentions (Oszmaniec & Szwarc, 2015). Historically, their main function was to block shots and prevent goals. However, in modern futsal, their role has expanded significantly to include active participation in the team's offensive phase. The evolution of the game, alongside regulatory changes by FIFA allowing goalkeepers to act as field players during live play (5vs4+GK), has prompted coaches and analysts to reconsider the tactical potential of goalkeepers, not only as defenders but also as auxiliary outfield players who can contribute to attack construction and ball circulation. This shift has been particularly evident in scenarios where the opponent applies high pressure during the build-up phase. In such cases, using the goalkeeper as an additional field player can help to break the press and create numerical superiority (Corrêa et al., 2014; Vicente-Vila & Lago-Peñas, 2016). Their increasing technical proficiency with their feet has facilitated this change, as observed in elite-level futsal (Amatria et al., 2021). In this vein, Méndez et al. (2019b) highlighted that although 5v4+GK strategies are more effective at maintaining possession, they do not necessarily translate into more goal-scoring opportunities, indicating that, while the tactic aids in controlling play, its offensive yield may be limited. Beyond these FIFA regulatory changes, evidence from stakeholders in Spain suggests that the post-2006 harmonization of futsal rules—particularly in sideline and corner restart procedures—diminished perceived spectacle and constrained adaptive behaviors of players, coaches, and referees, as shown in a descriptive cross-sectional study combining questionnaires and field diaries (Cachon Zagalaz, et al., 2014).

The link between space, numerical balance, and pressure is crucial in understanding the success of offensive strategies in futsal. Similar dynamics have been observed in football, where teams facing low defensive resistance were more successful at creating scoring chances, and ball possession improved when teams were able to manage opponent pressure effectively (Schulze et al., 2019; Forcher et al., 2024). Recent futsal-specific studies provide deeper insight into this phenomenon. Vicente-Vila and Lago-Peñas (2016) concluded that the inclusion of the goalkeeper as a fifth field player significantly improves possession effectiveness, especially in short possessions under low defensive pressure. Silva et al. (2021) similarly observed that the primary offensive role of goalkeepers in both professional and amateur games is to support ball retention, with direct contributions to goal scoring remaining sporadic. Furthermore, Szwarc and Oszmaniec (2020; 2021) found that, among top-level

teams, most goalkeeper actions during offensive play were aimed at gaining territory and initiating build-up phases. Interestingly, their studies noted that the game's score (winning, drawing, or losing) had minimal impact on the style and frequency of these actions, suggesting a consistent offensive role regardless of match context. Additionally, the tactical decision to use an outfield goalkeeper alters the physical dynamics of play. According to De Jong et al. (2022), teammates of an outfield goalkeeper covered less distance at high intensity (above 15.4 Km/h), indicating a more positionally oriented offensive structure during such scenarios. This reinforces the idea that involving the goalkeeper in outfield roles is not merely a reactive tactic, but a deliberate strategy requiring coordination, technical execution, and tactical awareness. Moreover, classic time-motion analysis in elite futsal quantified the spatial-temporal demands on players, demonstrating alternating bouts across five displacement rhythms (walking, jogging, medium speed, high speed, and sprint), with frequent lateral and backward movements and ball-carrying runs—constraints that heighten the need for rapid perception—action coupling, including for goalkeepers (Hernández, 2001).

Collectively, the reviewed evidence reinforces the evolving perception that futsal goalkeepers are no longer limited to defensive responsibilities within their own third of the court. Rather, they are emerging as dynamic contributors to the offensive phase, particularly in structured build-up play and in maintaining possession under high pressure. While their direct involvement in goal-scoring opportunities may remain secondary, their participation is increasingly recognized as critical for establishing and sustaining favorable attacking conditions in contemporary futsal. In this vein, we explicitly foreground the contextual variables that most strongly constrain goalkeeper behavior, thus considering the time of play, operationalized in four 10-min segments, the match status (draw, winning, or losing), and strategic situation, in terms of the immediate game context captured through defensive pressure on the ball and numerical configuration, including goalkeeper-as-outfield (5v4+GK). These variables are not ancillary; they are primary constraints shaping the timing, risk profile, and technique of goalkeeper interventions in possession. Empirically, the interaction of match time and scoreline is decisive. Coaches more frequently adopt 5v4+GK under adverse scorelines in late, 'critical' minutes, and goals scored or conceded in this configuration are tightly conditioned by these situational factors, with short and precise attacks being most effective (Méndez-Domínguez et al., 2019; 2021; Vicente-Vila & Lago-Peñas, 2016). Defensive pressure further moderates

goalkeeper effectiveness because ball possession success increases when pressure is low and sequences are brief, conditions under which goalkeepers more profitably act as facilitators in build-up (Vicente-Vila & Lago-Peñas, 2016; FIFA Technical Study Group, 2021). Numerical superiority with an outfield goalkeeper also reconfigures physical and positional demands, reducing teammates' high-intensity running while requiring greater locomotor output from the goalkeeper and supporting a more stable positional structure (De Jong et al., 2022). Furthermore, match status alone does not always determine an elite goalkeeper's style across all actions, but situational clusters emerge when scoreline is considered jointly with time and pressure, which justifies considering these contextual factors (Szwarc & Oszmaniec, 2021; Méndez-Domínguez et al., 2019). Therefore, to fulfil this expanded role, goalkeepers must possess not only traditional defensive competencies but also technical proficiency with the ball comparable to that of outfield players. However, this dual skill set is relatively rare and likely restricted to players competing at the highest levels of the sport. Accordingly, the aim of the present study was to examine the differential impact of goalkeeper involvement on offensive effectiveness, specifically in terms of goal-scoring opportunities, goals scored, and team ball possession, between professional (*Liga Nacional de Fútbol Sala*) and amateur (2nd and 3rd division) Spanish futsal leagues during the same competitive season. It was hypothesized that goalkeeper participation in attacking phases would have a distinct influence across competition levels, contributing more significantly to ball possession and the creation of scoring opportunities and goals in professional futsal compared to amateur levels.

Methods

Observational Design

This investigation employed a nomothetic, punctual, and multidimensional observational design, consistent with the canonical framework of systematic observational methodology. This design typology ensures scientific rigor when analyzing naturally occurring behaviors in complex sport settings.

Following Anguera & Hernandez-Mendo (2014), a nomothetic approach was adopted to capture behavioral variability across a broad set of goalkeepers; a punctual structure was selected, as observations were confined to a single competitive season; and a multidimensional configuration was used to incorporate several interacting

behavioral dimensions including contextual, spatial, technical, and outcome-related variables. The study adhered to established observational principles regarding ecological validity, perceptual exhaustiveness, and systematic coding structures recommended for mixed-methods observational sport research.

Participants

A total of 26 goalkeepers were included in the analysis. Across the 2023–2024 season, these goalkeepers accounted for 529 goalkeeper-outfield participations in the Spanish *Liga Nacional de Fútbol Sala* (LNFS) and 244 participations in Spanish amateur futsal leagues (2nd and 3rd divisions). A formal *a priori* power analysis was not feasible because the study did not prospectively recruit participants from a defined population; instead, it exhaustively included all available observations (convenience census) from the target competitions during the observation period. Consistent with current recommendations on transparent sample size reporting, we explicitly justify this choice and delineate the inferential scope of our analyses (i.e., estimation, pattern detection, and hypothesis-generating insights rather than confirmatory hypothesis testing with prospective power guarantees). As outlined by Lakens (2022), acceptable justifications include (a) collecting data from (almost) the entire available population and (b) explicitly acknowledging when a traditional *a priori* power analysis is not applicable due to design constraints. The league permitted the use of images for research purposes. The Blanquerna Research Committee approved the protocol and procedures with reference number 2425006D and granted that the study complies with the European data protection regulation (General Data Protection Regulation) regarding the processing of publicly available team-sport data.

The matches were systematically analyzed following the systematic observational methodology (Anguera et al., 2011). LINCE PLUS software (Soto et al., 2021) was used for notational analysis, and the data were transferred to Microsoft Excel (Microsoft Excel 2016, Microsoft Corporation, Redmond, WA, USA) and SPSS (IBM SPSS Statistics Version 30.0, IBM Corp., Armonk, NY, USA) for further analysis. All data were recorded using concurrent time-based (Type IV) observational recording, allowing multiple dimensions to co-occur within the same behavioral event. Content validation followed the criterion of authority within systematic observational methodology. Four experts (national futsal coach of the *Real Federación Española de Fútbol*) independently rated the conceptual adequacy and

clarity of each criterion and category (response options: YES/NO). An item was included if ≥ 3 experts responded YES; otherwise, it was excluded or revised. Following Aixa-Requena et al. (2025), we computed the percentage of positive coincidences by counting YES–YES agreements across all expert pairs for every item (with six pairs per item) and dividing by the total possible pairs. We then derived a two-sided exact binomial 95% confidence interval for the overall agreement rate. This authoritybased validation procedure conforms to the canonical prescriptions of the systematic observational methodology for developing ad hoc instruments (Anguera & Blanco, 2003; Anguera et al., 2011).

Two experienced observers (8 years of experience in the notational analysis of futsal events using LINCE), participated in the intra- and inter-rater reliability process using 10% of the sample. The observers' data were compared using Cohen's Kappa index (κ) (Robinson & O'Donoghue, 2007), obtaining a very good agreement between both independent observers.

Observational Instrument. Criteria and Categories

Table 1 shows the criteria, the categories, the codes and a description of the observational tool.

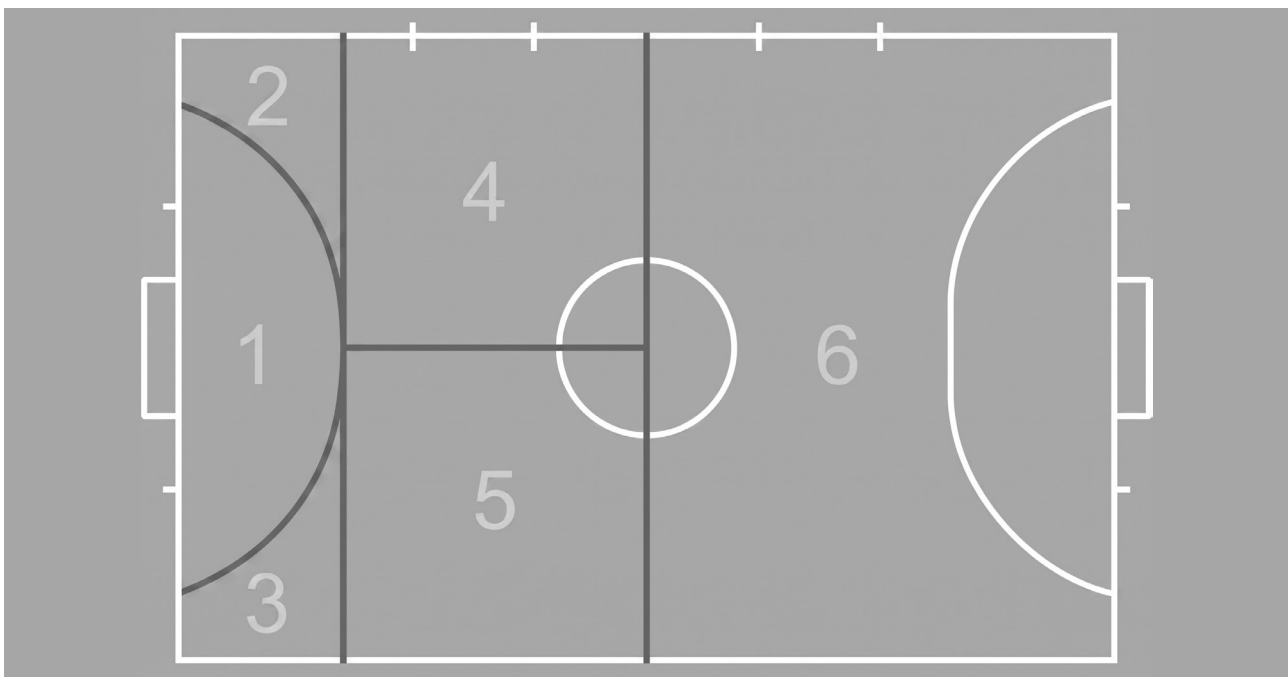
Table 1
Observational Tool for the Analyses

Criteria	Category	Code	Description
Score	Winning 2 goals	W2	Goalkeeper's team winning by 2 goals or more
	Winning 1 goal	W1	Goalkeeper's team winning by 1 goal
	Draw	D	Draw
	Losing 1 goal	L1	Goalkeeper's team losing by 1 goal
	Losing 2 goals	L2	Goalkeeper's team losing by 2 goals or more
Moment of the match	Moment 0-10	M10	Time from 0 to 9:59 min
	Moment 10-20	M20	Time from 10 to 19:59 min
	Moment 20-30	M30	Time from 20 to 29:59 min
	Moment 30-40	M40	Time from 30 to 40 min
Pressure on the ball	No pressure	NOPR	No-possessing team does not apply pressure
	Pressure players	PRPL	No-possessing team applies pressure to all outfield players, but not to the goalkeeper
	Pressure all	PRALL	No-possessing team applies pressure to all opposing players (including the goalkeeper)
Receiving technique	Hand reception	HAND	Goalkeeper takes the ball with the hands
	Foot reception	FOOT	Goalkeeper takes the ball with the foot
Origin of the ball	Partner	PART	Partner passes the ball to the goal-keeper
	Opponent	OPP	Ball arrives at the goalkeeper from an opponent
Reception zone (see figure 1)	Reception zone 1	R1	Goalkeeper receives the ball in zone 1
	Reception zone 2	R2	Goalkeeper receives the ball in zone 2
	Reception zone 3	R3	Goalkeeper receives the ball in zone 3
	Reception zone 4	R4	Goalkeeper receives the ball in zone 4
	Reception zone 5	R5	Goalkeeper receives the ball in zone 5
	Reception zone 6	R6	Goalkeeper receives the ball in zone 6
Action zone (see figure 1)	Action zone 1	A1	Goalkeeper executes the action in zone 1
	Action zone 2	A2	Goalkeeper executes the action in zone 2
	Action zone 3	A3	Goalkeeper executes the action in zone 3
	Action zone 4	A4	Goalkeeper executes the action in zone 4
	Action zone 5	A5	Goalkeeper executes the action in zone 5
	Action zone 6	A6	Goalkeeper executes the action in zone 6

Table 1 (Continuation)
Observational Tool for the Analyses

Criteria	Category	Code	Description
Goalkeeper action	Bowling pass	BOW	Goalkeeper performs a bowling pass
	Baseball pass	BAS	Goalkeeper performs a baseball pass
	Parabolic pass	PAR	Goalkeeper performs a parabolic pass
	Short pass	SHORT	Goalkeeper performs a short pass
	Long pass	LONG	Goalkeeper performs a long pass
	Head hit	HEAD	Goalkeeper hit the ball with the head
	Dribbling an opponent	DRIB	Goalkeeper performs a dribble against an opponent
	Shot to target	SHOT	Goalkeeper shots to the target
	Ball refuses	REF	Goalkeeper refuses the ball
Action outcome (positive)	Goal goalkeeper	GOG	Goalkeeper scores
	Goal goalkeeper's team	GOT	Goalkeeper's team scores
	Chance created	CHA	Goalkeeper's team creates a chance to score
	Possession ball	POSS	Goalkeeper's team keep the ball
	Progression ball	PROG	Goalkeeper's team progresses 1 line of pressure (1 line = 10 m)
	Ball out	OUT	Ball out of the court in favor of the goalkeeper's team
Action outcome (negative)	Opponent's goal	OPSC	Opponent team scores
	Opponents chance	OPCH	Opponent team creates a chance to score
	Recuperation goalkeeper	RECG	Opponent team regains possession following a goalkeeper error
	Recuperation player	RECP	Opponent team regains possession following an outfield player error
	Ball out goalkeeper	OUTG	Ball out of the court favoring the opponent team following a goalkeeper intervention
	Ball out player	OUTP	Ball out of the court favoring the opponent team following an outfield player intervention

Figure 1
Court Zones (Vicente-Vila & Lago-Peñas, 2016)



Procedures

Video footage of the professional matches was obtained from the official website of the *Real Federación Española de Fútbol*. Amateur matches were registered in agreement with the local teams and the corresponding federative authorities. Goalkeeper interventions were observed frame-by-frame from a side view of the court. Two experienced observers, each with eight years of specialist experience in futsal notational analysis using LINCE and LINCE Pro, independently coded 32 interventions from professional futsal matches (11% of the total sample, randomly selected), and 25 interventions from amateur futsal matches (10% of the total sample, randomly selected) under identical viewing conditions and blinded to each other's work and to the study hypotheses, following frame-by-frame procedures. To assess inter-rater reliability, both observers coded the same video subset concurrently, and their coding was compared using Cohen's kappa (κ), which yielded values ranging from .87 to 1, indicating very good to almost perfect agreement according to established benchmarks in performance analysis research. For intra-rater reliability, the principal observer re-coded the same clips after a 10–15-day washout interval, consistent with validated temporal stability protocols described in observational methodology, again producing κ values between .89 and 1, demonstrating strong stability of coding decisions over time. Cohen's kappa was calculated using IBM SPSS Statistics Version 30.0.0.

Statistical Analysis

To test the hypothesis that the behavior of amateur and professional futsal goalkeepers differs across multiple observed categories, a multi-step advanced statistical analysis was conducted. Firstly, a Principal Component Analysis (PCA) was applied to one-hot encoded categorical data to explore underlying patterns and visualize potential differentiation in goalkeeper behaviors based on competitive level (Standard 1 for amateur, Standard 2 for professional). Although PCA is not inherently designed for categorical data, it was used here as a surrogate for Multiple Correspondence Analysis (MCA), which could not be implemented in the current computational environment. Then, a supervised classification approach using a Random Forest classifier

was employed to evaluate the predictability of goalkeeper level based on game-action variables. Model performance was assessed using classification accuracy, a confusion matrix, and a variable importance ranking. Furthermore, a multinomial logistic regression was used to identify which variables significantly contributed to distinguishing between amateur and professional goalkeepers. Due to convergence issues in full models, a reduced model using the top 10 most important predictors (from the Random Forest model) was fitted to obtain interpretable coefficients. Finally, unsupervised clustering was performed using the k-means algorithm on the encoded dataset to identify natural groupings of goalkeeper behaviors without using level labels. The resulting clusters were cross-tabulated with goalkeeper type to assess alignment with known classifications. All statistical procedures were executed using Python (version 3.11), with libraries including scikit-learn, statsmodels, pandas, and matplotlib.

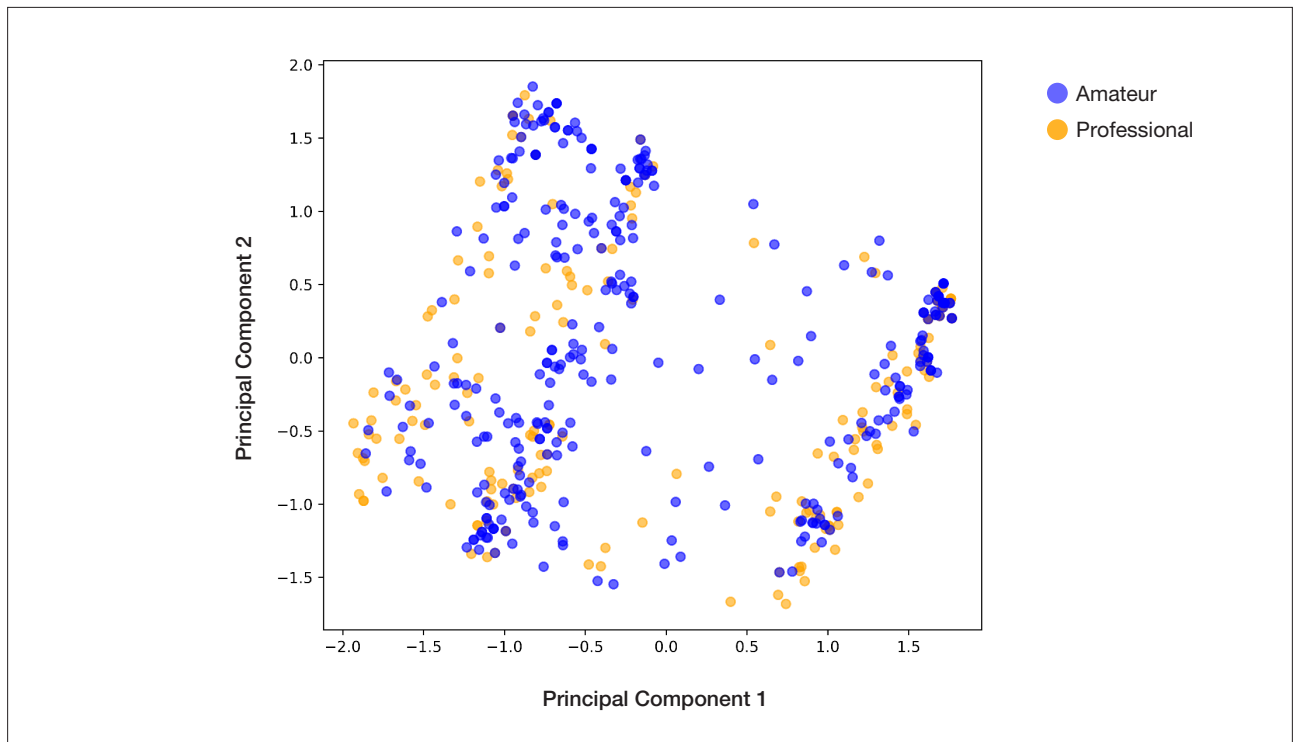
Results

Figure 2 presents a Principal Component Analysis biplot showing the first two components derived from categorical game data. A partial visual separation was observed between amateur and professional goalkeepers, with some overlap, suggesting underlying behavioral distinctions. The Random Forest classifier achieved an overall classification accuracy of 71.1%, with higher precision for professional goalkeepers (77.7%) compared to amateurs (61.5%). The confusion matrix is shown in Figure 3.

Table 2 lists the top 10 most important features for classification based on Gini importance scores from the Random Forest model. Variables such as “Moment of the match: M30” and “Action outcome: PROG” were prominent discriminators. Due to multicollinearity limitations, the multinomial logistic regression was conducted using only the top predictors. Table 3 displays the estimated coefficients, where positive values indicate a higher likelihood of professional goalkeeper classification.

k-means clustering resulted in two groups, with Cluster 1 composed of 66.8% professional goalkeepers and Cluster 0 composed of 52.9% amateur goalkeepers. Figure 4 depicts the cluster composition. Table 4 summarizes the modal characteristics of each cluster, highlighting distinct behavioral profiles for each group.

Figure 2
Principal Component Analysis (PCA) Differentiating Amateur and Professional Futsal Goalkeepers Based on Encoded Contextual, Technical, and Outcome Variables



Note. Data were one-hot encoded prior to PCA, producing two principal components that summarize multivariate behavioral patterns across goalkeeper interventions.

Figure 3
Confusion Matrix Depicting the Classification Performance of the Random Forest Model Differentiating Amateur and Professional Goalkeepers

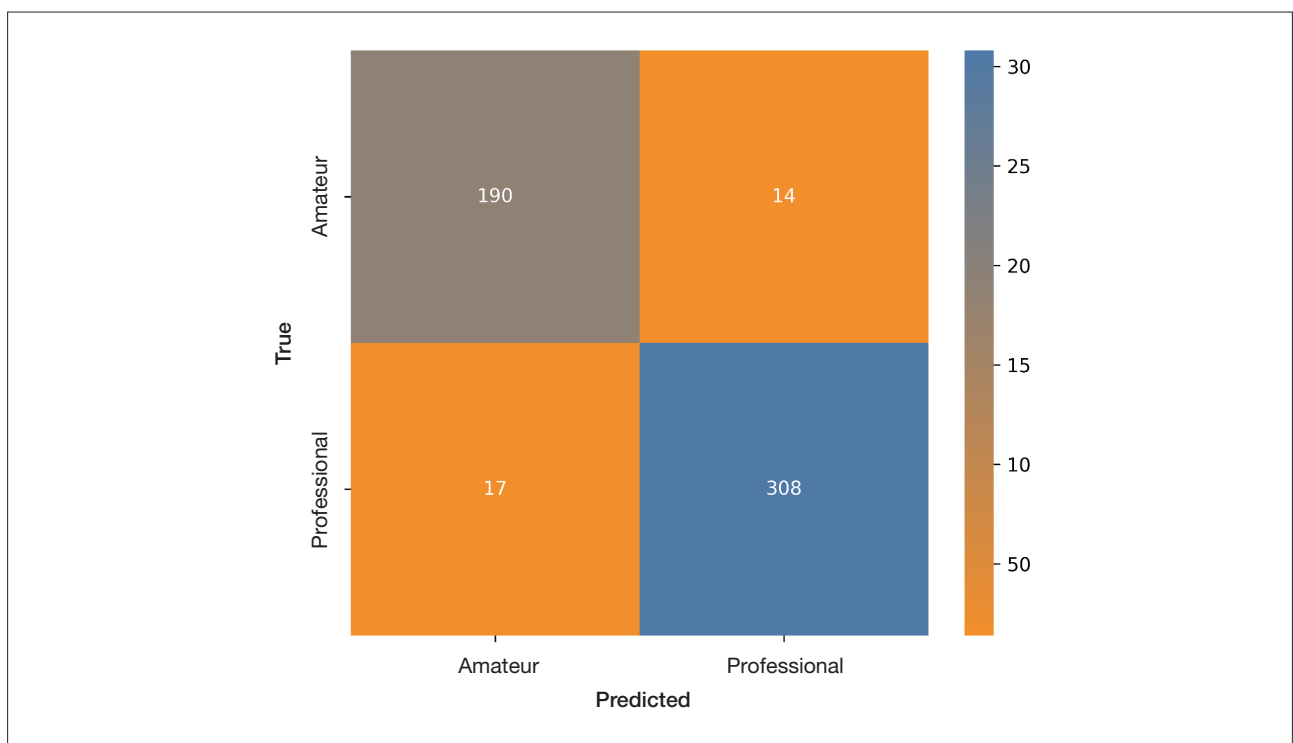


Table 2
Top 10 Most Important Variables (Random Forest)

Feature (Encoded Category = Value)	Importance
Score_W2	0.0537
Moment of the match_M10	0.0457
Moment of the match_M30	0.0444
Moment of the match_M40	0.0413
Score_D	0.0391
Pressure on the ball_NOPR	0.0373
Action outcome_PROG	0.0354
Moment of the match_M20	0.0348
Score_L2	0.0335
Action outcome_POSS	0.0326

Note. Score: D = Draw, W1 = Win by 1, W2 = Win by 2+, L1 = Lose by 1, L2 = Lose by 2+; Moment of the match: M10 = 0-10 min, M20 = 10-20 min, M30 = 20-30 min, M40 = 30-40 min; Pressure on the ball: NOPR = No pressure, PRPL = Pressure to players, PRALL = Full pressure; Receiving technique: HAND = Hands, FOOT = Foot; Origin of the ball: PART = Partner, OPP = Opponent; Reception/Action zone: R1 and A1 (see Figure 1); Goalkeeper action: BOW = Bowling pass, SHORT = Short pass; Action outcome: POSS = Keep possession.

Table 3
Logistic Regression Coefficients (Professional vs Amateur)

Feature (Encoded Category = Value)	Importance
const	0.7105
Moment of the match_M30	0.4123
Action outcome_PROG	0.2317
Action outcome_POSS	0.1939
Moment of the match_M20	0.1911
Moment of the match_M10	0.1764
Pressure on the ball_NOPR	0.1665
Moment of the match_M40	-0.0692
Score_D	-0.5641
Score_L2	-0.9335
Score_W2	-1.2566

Note. Score: D = Draw, W1 = Win by 1, W2 = Win by 2+, L1 = Lose by 1, L2 = Lose by 2+; Moment of the match: M10 = 0-10 min, M20 = 10-20 min, M30 = 20-30 min, M40 = 30-40 min; Pressure on the ball: NOPR = No pressure, PRPL = Pressure to players, PRALL = Full pressure; Receiving technique: HAND = Hands, FOOT = Foot; Origin of the ball: PART = Partner, OPP = Opponent; Reception/Action zone: R1 and A1 (see Figure 1); Goalkeeper action: BOW = Bowling pass, SHORT = Short pass; Action outcome: POSS = Keep possession.

Figure 4
Distribution of Amateur (orange) and Professional (blue) Goalkeepers Within Each K means Cluster: Cluster Composition Reflects Similarity of Encoded Behavioral Profiles

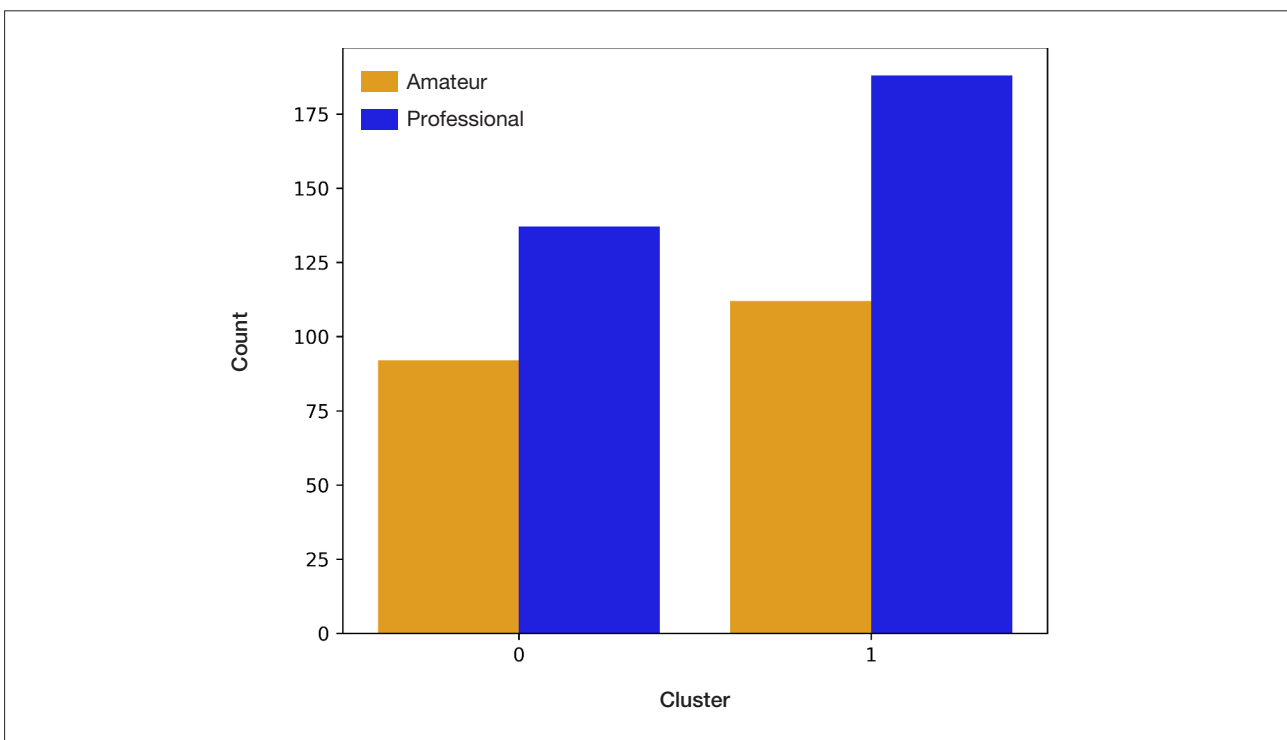


Table 4
Dominant Characteristics (Codes) per Cluster (K-means)

Cluster	Score	Moment of the match	Pressure on the ball	Receiving technique	Origin of the ball	Reception zone	Action zone	Goalkeeper action	Action outcome
0	D	M10	NOPR	HAND	OPP	R1	A1	BOW	POSS
1	D	M20	NOPR	FOOT	PART	R1	A1	SHORT	POSS

Note. Score: D = Draw, W1 = Win by 1, W2 = Win by 2+, L1 = Lose by 1, L2 = Lose by 2+; Moment of the match: M10 = 0–10 min, M20 = 10–20 min, M30 = 20–30 min, M40 = 30–40 min; Pressure on the ball: NOPR = No pressure, PRPL = Pressure to players, PRALL = Full pressure; Receiving technique: HAND = Hands, FOOT = Foot; Origin of the ball: PART = Partner, OPP = Opponent; Reception/Action zone: R1 and A1 (see Figure 1); Goalkeeper action: BOW = Bowling pass, SHORT = Short pass; Action outcome: POSS = Keep possession.

Discussion

The aim of this study was to investigate the offensive behaviors of futsal goalkeepers at different levels of competition, with the expectation that professional and amateur goalkeepers would demonstrate distinctive tactical profiles. The findings confirm this hypothesis, suggesting clear and systematic differences in behavior based on competitive level. These differences are manifested in the timing, type, and purpose of goalkeeper interventions during offensive phases.

The Principal Component Analysis (Figure 2) demonstrated a partial but notable separation between amateur and professional goalkeepers. This spatial divergence suggests an underlying structure of behavioral traits that correspond to player level. As observed in previous studies, elite goalkeepers in futsal are expected to participate more actively in offensive sequences, not only by initiating play but also by adapting their actions to evolving game contexts (Vicente-Vila & Lago-Peñas, 2016; Méndez et al., 2019b). The separation detected through PCA echoes findings from 11-a-side football, where similar analyses revealed differentiated spatial and temporal positioning of goalkeepers across competition levels (Lamas et al., 2018; Bassek et al., 2025). Supervised classification using a Random Forest model (Table 3) provided further support for this separation, achieving 71.1% accuracy in classifying goalkeeper level based solely on offensive action descriptors. Among the most predictive variables were contextual elements such as the “moment of the match: M30” and tactical outcomes such as progressive action. These variables correspond to behaviors previously described in the literature as indicative of strategic involvement, where elite goalkeepers operate as facilitators in build-up sequences rather than mere distributors (Paz-Franco et al., 2014; Szwarc & Oszmaniec, 2020). Professional goalkeepers were more likely to receive the ball from teammates and engage in short, precise passes under pressure, actions that demand high technical execution and rapid decision-making (Vilar et al., 2014). These findings are

consistent with the work of Paz-Franco et al. (2014), who emphasize that tactical decision-making under pressure is a key differentiator between elite and sub-elite performers. Conversely, amateur goalkeepers tended to rely more on safer options such as hand receptions and bowling passes, particularly in early match stages (M10), reflecting a risk-averse and less versatile behavioral pattern. This rigidity was also observed in the work of Szwarc and Oszmaniec (2020), who argued that amateur goalkeepers generally engage in low-risk actions to retain possession rather than to generate offensive advantage. These results align with Méndez et al. (2019a), who found that top-ranked futsal teams adopt highly coordinated attacking profiles that often rely on the goalkeeper as an active component of the attacking structure, contributing to numerical superiority and facilitating dynamic positional rotations. This may explain the increased prevalence of progressive and context-aware actions observed in professional goalkeepers. Moreover, Corrêa et al. (2014) demonstrated that when goalkeepers assume outfield roles, the opposing team’s defensive organization is directly impacted, often leading to spatial disorganization. The strategic use of the goalkeeper as an additional attacker, therefore, is not just a technical or tactical choice but a systemic adaptation that reshapes team dynamics on both ends of the court. Additionally, Méndez-Domínguez et al. (2021) demonstrated that the strategic use of the fly goalkeeper, particularly in the final moments of elite futsal matches, is influenced by game status and match context, showing that goals scored using this strategy are highly dependent on situational conditions. This supports our finding that professional goalkeepers are not only technically skilled but tactically adaptive, deploying offensive interventions selectively in response to time-sensitive and score-sensitive match demands. Their study underscores that fly goalkeeper use is not random but governed by shared patterns in critical phases, which may explain the structured yet flexible actions observed in our elite participants.

The logistic regression analysis (Table 3) further substantiated the Random Forest findings, showing that technical actions such as foot reception, short passing, and receiving from teammates were positively associated with professional level. These elements suggest a higher degree of tactical integration, as supported by De Jong et al. (2022), who described the elite goalkeeper as a positional support in modern offensive schemes. The offensive role of the goalkeeper in futsal is not limited to restarting play but involves real-time problem-solving and the manipulation of space, often under pressure, to preserve or improve positional advantage (Travassos et al., 2012).

The k-means clustering (Figure 3, Table 4) suggests two clear profiles: one dominated by professional goalkeepers (Cluster 1), and the other more associated with amateurs (Cluster 0). Cluster 1's dominant behaviors included receiving the ball from a teammate, acting in later phases of the game (M20+), and opting for short or progressive passes. This aligns with previous characterizations of professional behavior as 'strategically delayed,' allowing for better interpretation of space and coordination with teammates (Szwarc & Oszmaniec, 2020; Vilar et al., 2014). By contrast, Cluster 0 behaviors, dominated by early-match actions and simpler passes, reflects more reactive and less structurally informed participation, which may stem from limited tactical training or reduced perceptual capacity (Wilkins et al., 2018). It is particularly noteworthy that amateur goalkeepers show a narrower behavioral repertoire. This might indicate that sub-elite futsal goalkeepers prioritize ball retention over dynamic offensive engagement. The supposed reduced tactical adaptability noted here may also stem from a lack of shared offensive patterns in amateur teams, as emphasized by Travassos et al. (2012), where synchronized decision-making across lines might be less developed.

From a methodological perspective, this study indicates the value of combining observational data with advanced mixed methods to investigate tactical behaviors in futsal (Camerino, Castañer & Anguera, 2012). Thus, stable tactical behaviors are best identified via repeated observations, context-sensitive analyses, and complementary analytical approaches rather than causal inference. This perspective supports interpreting our multivariate results (Random Forest, logistic regression, clustering) as convergent evidence of robust, recurring patterns in goalkeeper-in-possession behaviors across contexts, strengthening coherence between design, analysis, and claims while avoiding over-attribution of effects (Pompa et al., 2024). The analytical process follows key principles in performance analysis, notably the use of contextualized notational systems, multidimensional

coding schemes, and multi-method triangulation as outlined by O'Donoghue (2010) and Hughes et al. (2019). The consistent use of categorical variables rooted in competition-relevant game situations strengthens the ecological validity of the dataset, a criterion emphasized by Anguera et al. (2011) in observational methodology. The integration of dimensionality reduction (PCA), supervised classification (Random Forest, logistic regression), and unsupervised clustering (k-means) offers a comprehensive framework that aligns with recent methodological trends in sports science. These techniques are particularly suitable for exploring complex interaction patterns without imposing restrictive *a priori* assumptions, a necessity in team sports where behaviors are emergent and nonlinear (Weiwei, 2021). In addition, methodological rigor is enhanced through reliability criteria consistent with the standards proposed by Anguera et al. (2017), such as the definition of exhaustive and mutually exclusive categories and the use of expert consensus during the design of the observational tool. The study also reflects the observational principles proposed by Lapresa et al. (2013), with a clear distinction between structural patterns and contextual dimensions, a feature necessary to properly account for tactical variability. These criteria are essential to ensure internal validity and the interpretative power of the conclusions drawn from coded game behavior. As demonstrated by Wilkins et al. (2018), combining qualitative and quantitative perspectives in sports analysis maximizes explanatory depth, especially when analyzing player-environment interactions such as those involving the goalkeeper. The current study adheres to these guidelines by using statistical models not only to classify but also to explain performance differences rooted in game context, tactical function, and temporal distribution of actions. This mixed strategy reflects best practices in contemporary performance analysis research, where the interaction between technical-tactical actions, game context, and player decision-making is analyzed as a dynamic system rather than a sequence of isolated events (Travassos et al., 2013; McLean et al., 2017).

Limitations

This study is observational and relies on a convenience census of goalkeeper offensive actions drawn from Spanish professional and amateur leagues within a single season; as such, causal inferences cannot be made, and the findings should be interpreted as exploratory associations rather than effects. The sampling frame (specific competitions, 2023–24 season) and contextual constraints (e.g., league styles,

tactical norms, and scheduling) may limit generalizability to other countries, competition formats, or future seasons. In addition, although we implemented rigorous coding procedures with very high inter- and intra-rater agreement and used multivariate models to detect patterns, model outputs (e.g., variable importance, clustering structure) remain contingent on the selected categories, the one-season window, and the ecological variability of match contexts; unmeasured factors (e.g., team tactics, coaching instructions, player fatigue), could partly account for the observed profiles. Together, these limitations recommend caution in interpretation and underscore the need for multi-season, multi-league replications and confirmatory designs before deriving prescriptive conclusions beyond settings similar to those analyzed.

Conclusions

To conclude, the data confirm that professional futsal goalkeepers not only possess superior technical abilities but are also tactically integrated actors who influence the game's offensive flow. Their decision-making is more contextually tuned, their actions more temporally distributed, and their role better aligned with positional play principles. These attributes are consistent with the increasing complexity and multifunctionality required at elite levels and should inform both scouting and training practices moving forward.

The findings of this study offer actionable guidance for coaches and practitioners seeking to optimize the offensive contribution of futsal goalkeepers across competitive levels. Professional teams can enhance their attacking structure by further integrating the goalkeeper into controlled build-up play, emphasizing foot-based receptions, short passing under pressure, and coordinated positional rotations that exploit numerical superiority and facilitate progression. In contrast, amateur teams should prioritize foundational technical work, particularly first-touch quality, body orientation, and simple short-passing connections, to reduce reliance on low-risk hand distributions and encourage tactical involvement beyond the early phases of play. Across levels, designing training tasks that incorporate contextual constraints such as match moment, defensive pressure, and ball origin can foster more adaptive, context-sensitive behaviors. By incorporating goalkeeper-inclusive positional play circuits, pressure-resistance drills, and structured support patterns, coaches can cultivate decision-making, technical precision, and tactical synergy, enabling goalkeepers to act not only as defenders but also as meaningful contributors to their team's offensive organization.

Funding

No funding was received.

Acknowledgements

The Python code for the data analysis was partially developed with the support of Artificial Intelligence tools (ChatGPT 4.0).

References

- Aixa-Requena, S., Camerino, O., & Iglesias, X. (2025). Observational analysis of an extreme skateboarding modality: downhill skateboarding. *Apunts Educación Física y Deportes*, 160, 35–48. [https://doi.org/10.5672/apunts.2014-0983.es.\(2025/2\).160.05](https://doi.org/10.5672/apunts.2014-0983.es.(2025/2).160.05)
- Amatria, M., Álvarez, J., Ramírez, J., & Murillo, V. (2021). Identification of the patterns produced in the offensive sequences that end in a goal in European futsal. *Frontiers in Psychology*, 12, 578332. <https://doi.org/10.3389/fpsyg.2021.578332>
- Anguera, M. T., Blanco-Villaseñor, Á., Hernández-Mendo, A., & Losada, J. L. (2011). Observational designs: Their suitability and application in sports psychology. *Cuadernos de Psicología del Deporte*, 11(2), 63–76.
- Anguera, M. T., & Hernández-Mendo, A. (2014). Metodología observacional y psicología del deporte: Estado de la cuestión. *Revista de Psicología del Deporte*, 23(1), 103–109.
- Anguera, M. T., Camerino, O., Castañer, M., Sánchez-Algarra, P., & Onwuegbuzie, A. J. (2017). The specificity of observational studies in physical activity and sports sciences: Moving forward in mixed methods research and proposals for achieving quantitative and qualitative symmetry. *Frontiers in Psychology*, 8, 2196. <https://doi.org/10.3389/fpsyg.2017.02196>
- Bassek, M., Rein, R., Weber, H., & Memmert, D. (2025). An integrated dataset of spatiotemporal and event data in elite soccer. *Scientific Data*, 12, 195. <https://doi.org/10.1038/s41597-025-04505-y>
- Cachon Zagalaz, J., Valdivia Moral, P. Á., Lara Sánchez, A., Zagalaz Sánchez, M. L., & Berdejo del Fresno, D. (2014). Questionnaire: Loss of Entertainment in Spanish Futsal (PEFSE)-Results Analysis. *American Journal of Sports Science and Medicine*, 2(3), 83–87.
- Camerino, O., Castañer, M., & Anguera, T. M. (Eds.). (2012). *Mixed methods research in the movement sciences: Case studies in sport, physical education and dance*. (1st ed.). Routledge. <https://doi.org/10.4324/9780203132326>
- Corrêa, U. C., Davids, K., Silva, S. L., Denardi, R. A., & Tani, G. (2014). The influence of a goalkeeper as an outfield player on defensive subsystems in futsal. *Advances in Physical Education*, 4(2), 84–92. <https://doi.org/10.4236/ape.2014.42012>
- De Jong, J. P. J., Caetano, F. G., De Jong, L. M. S., Da Silva, V., Bueno, M. J. D. O., Santiago, P. R. P., Vieira, L.H.P., Nakamura, F.B. & Moura, F. A. (2022). The influence of the futsal outfield goalkeeper on players' running performance. *Human Movement*, 23(3), 49–55. <https://doi.org/10.5114/hm.2022.107977>
- FIFA Technical Study Group. (2021). *FIFA Futsal Analysis Framework* (FIFA Futsal World Cup Lithuania 2021). FIFA Training Centre. <https://www.fifatrainingcentre.com/en/game/tournaments/fifa-futsal-world-cup/fifa-futsal-analysis-framework.php>
- Forcher, L., Altmann, S., Jekauc, D., & Kempe, M. (2024). The keys of pressing to gain the ball—Characteristics of defensive pressure in elite soccer using tracking data. *Science and Medicine in Football*, 8(2), 161–169. <https://doi.org/10.1080/24733938.2022.2158213>
- Hernández, J. (2001). Anàlisi dels paràmetres espai i temps en el futbol sala. La distància recorreguda, el ritme i la direcció del desplaçament del jugador durant un partit de competició. *Apunts. Educació física i esports*, 3(65), 32–44.
- Hughes, M., Franks, I., Franks, I. M., & Dancs, H. (Eds.). (2019). *Essentials of performance analysis in sport*. Taylor & Francis.

- Lakens, D. (2022). Sample size justification. *Collabra: Psychology*, 8(1), 33267. <https://doi.org/10.1525/collabra.33267>
- Lamas, L., Barreira, D., Ribeiro, L., Moura, F. A., & Silva, P. (2018). Analytic method for evaluating players' decisions in team sports: Applications to the soccer goalkeeper. *PLOS ONE*, 13(2), e0191431. <https://doi.org/10.1371/journal.pone.0191431>
- Lapresa, D., Álvarez, L., Arana, J., Garzón, B., & Caballero, V. (2013). Observational analysis of the offensive sequences that ended in a shot by the winning team of the 2010 UEFA Futsal Championship. *Journal of Sports Sciences*, 31(15), 1731–1739. <http://dx.doi.org/10.1080/0264014.2013.803584>
- McLean, S., Salmon, P. M., Gorman, A. D., Read, G. J. M., & Solomon, C. (2017). What's in a game? A systems approach to enhancing performance analysis in football. *PLoS ONE*, 12(2), e0172565. <https://doi.org/10.1371/journal.pone.0172565>
- Méndez, C., Gonçalves, B., Santos, J., Ribeiro, J. N., & Travassos, B. (2019a). Attacking profiles of the best ranked teams from elite futsal leagues. *Frontiers in Psychology*, 10, Article 1370. <https://doi.org/10.3389/fpsyg.2019.01370>
- Méndez, C., Gómez, M. A., Rúiz, L. M., & Travassos, B. (2019b). Goalkeeper as an outfield player: shooting chances at critical moments in elite futsal. *International Journal of Performance Analysis in Sport*, 19(2), 179–191. <https://doi.org/10.1080/24748668.2019.1581967>
- Méndez-Domínguez, C., Bores-García, D., Ruiz-Barquín, R., Gómez-Ruano, M., & Ruiz-Pérez, J. M. (2021). Situational and game conditioning factors in goals scored with a fly goalkeeper in futsal. *Apunts. Educación Física y Deportes*, 143, 33–43. [https://doi.org/10.5672/apunts.2014-0983.es.\(2021/1\).143.05](https://doi.org/10.5672/apunts.2014-0983.es.(2021/1).143.05)
- Méndez-Domínguez, C., Gómez-Ruano, M. A., Rúiz-Pérez, L. M., & Travassos, B. (2019). Goals scored and received in 5vs4 GK game strategy are constrained by critical moment and situational variables in elite futsal. *Journal of Sports Sciences*, 37(21), 2443–2451. <https://doi.org/10.1080/0264014.2019.1640567>
- O'Donoghue, P. (2010). *Research methods for sports performance analysis*. Routledge.
- Oszmaniec, M., & Szwarc, A. (2015). The efficiency of actions of goalkeepers from sports effective teams in a game of futsal in matches of the final tournament of the World and European Championships in 2012. *Baltic Journal of Health and Physical Activity*, 7(4), 15–27. <https://doi.org/10.29359/BJHPA.07.4.02>
- Paz-Franco, A., Bores-Cereza, A., Barcala-Furelos, R., & Mecias-Calvo, M. (2014). Analysis of the conducts of elite futsal goalkeeper in the different situations of the game. *American Journal of Sports Science and Medicine*, 2(3), 71–76. <https://doi.org/10.12691/ajssm-2-3-1>
- Pompa, D., Caporale, A., Carson, H. J., Beato, M., & Bertollo, M. (2024). Influence of the constraints associated with the numerical game situations on the technical-tactical actions of U-11 football players in Spain: A commentary on Garcia-Angulo et al. (2024). *International Journal of Sports Science & Coaching*, 19(6), 2530–2533. <https://doi.org/10.1177/17479541241268148>
- Robinson, G., & O'Donoghue, P. (2007). A weighted kappa statistic for reliability testing in performance analysis of sport. *International Journal of Performance Analysis in Sport*, 7(1), 12–19. <https://doi.org/10.1080/24748668.2007.11868383>
- Schulze, E., Clemens, C., Nopp, S., & Meyer, T. (2019). Defensive balance in elite football: Exploring the development of goal scoring opportunities. *Sport Performance & Science Reports*, (67), 1–15.
- Silva, S. L. D., Gemas Neto, E., Palma, G. C. D. S., Silva Filho, A. S., & Corrêa, U. C. (2021). Os comportamentos antecipatório e de tempo de reação do goleiro do futsal. *Journal of Physical Education*, 32, e3218. <https://doi.org/10.4025/jphyseduc.v32i1.3218>
- Soto, A., Camerino, O., Iglesias, X., Anguera, M. T., Castañer, M. (2021). LINC PLUS software for systematic observational studies in sports and health. *Behavior Research Methods*, 54, 1263–1271. <https://doi.org/10.3758/s13428-021-01642-1>
- Szwarc, A., & Oszmaniec, M. (2020). A model of the efficiency of goalkeepers' actions in futsal. *Human Movement*, 21(4), 44–53. <https://doi.org/10.5114/hm.2020.95990>
- Szwarc, A., & Oszmaniec, M. (2021). The efficiency of action of futsal goalkeepers in game situations with varying results of competition. *Pedagogy of Physical Culture and Sports*, 25(2), 98–107. <https://doi.org/10.15561/26649837.2021.0204>
- Szwarc, A., Lipinska, P., & Chamera, M. (2010). The efficiency model of goalkeeper's actions in soccer. *Baltic Journal of Health and Physical Activity*, 2(2), 5. <https://doi.org/10.2478/v10131-0013-x>
- Travassos, B., Araujo, D., Davids, K., Vilar, L., Esteves, P. T., & Vanda, C. (2012). Informational constraints shape emergent functional behaviors during performance of interceptive actions in team sports. *Psychology of Sport and Exercise*, 13(2), 216–223. <https://doi.org/10.1016/j.psychsport.2011.11.009>
- Travassos, B., Davids, K., Araújo, D., & Esteves, P. T. (2013). Performance analysis in team sports: advances from an ecological dynamics approach. *International Journal of Performance Analysis in Sport*, 13(1), 83–95. <https://doi.org/10.1080/24748668.2013.11868633>
- Vicente-Vila, P., & Lago-Peñas, C. (2016). The goalkeeper influence on ball possession effectiveness in futsal. *Journal of Human Kinetics*, 51, 217–224. <https://doi.org/10.1515/hukin-2015-0185>
- Vilar, L., Araujo, D., Davids, K., & Button, C. (2014). The role of ecological dynamics in analyzing performance in team sports. *Sports Medicine*, 42(1), 1–10. <https://doi.org/10.2165/11596520-000000000-00000>
- Weiwei, H. (2021). Classification of sport actions using principal component analysis and random forest Based on three-dimensional data. *Displays*, 72, 102135. <https://doi.org/10.1016/j.displa.2021.102135>
- Wilkins, L., Nelson, C., & Tweddle, S. (2018). Stroboscopic visual training: a pilot study with three elite youth football goalkeepers. *Journal of Cognitive Enhancement*, 2(1), 3–11. <https://doi.org/10.1007/s41465-017-0038-z>

Conflict of interest: no conflict of interest was reported by the authors.



© Copyright Generalitat de Catalunya (INEFC). This article is available at the URL <https://www.revista-apunts.com/en/>. This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in the credit line; if the material is not included under the Creative Commons license, users will need to obtain permission from the license holder to reproduce the material. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>