

Notational analysis of the Croatian first football league: Technical, tactical and performance indicators during the 2025/2026 season

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ABSTRACT

The aim of this study was to analyse technical and tactical performance indicators in the Croatian First Football League (SuperSport HNL) during the 2025/2026 competitive season. Match analysis has become an essential tool in modern football, allowing coaches, analysts, and researchers to identify performance patterns associated with successful outcomes. This study evaluated offensive and defensive parameters, possession-based indicators, passing efficiency, shots on target, expected goals (xG), pressing intensity, and situational variables related to match outcome. Data were collected from official league statistics and video analysis platforms across all league matches during the observed season. Variables included total passes, successful passes, possession percentage, shots, shots on target, expected goals, duels won, high-intensity pressing actions, recoveries in the final third, and set-piece efficiency. Descriptive statistics and inferential analyses were applied to determine differences between winning, drawing, and losing teams. The results demonstrated that winning teams achieved significantly greater passing accuracy, higher xG values, more successful high pressing sequences, and increased efficiency in transition phases. Teams positioned in the upper part of the league table also showed greater tactical compactness and offensive organization compared to lower-ranked teams. Furthermore, home teams demonstrated statistically significant advantages in ball possession and attacking efficiency. The findings contribute to the growing body of literature regarding notational analysis in elite football and provide practical implications for coaches, analysts, and performance specialists working within Croatian and European football environments.

Keywords: performance analysis; football; notational analysis; Croatian football league; tactical analysis; match statistics; elite football.

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INTRODUCTION

Modern football has evolved into a highly complex and analytically driven sport in which scientific performance evaluation plays a central role in competitive success. The rapid development of sports analytics, positional tracking systems, machine learning models, and tactical data platforms has fundamentally transformed how coaches, analysts, and researchers interpret football performance. In elite football environments, notational analysis has become one of the most important scientific methods for objectively quantifying technical, tactical, and situational aspects of match play (Almeida et al., 2024).

Notational analysis allows systematic observation, recording, and classification of match events in order to identify behavioural and tactical patterns associated with successful performance outcomes. Through modern analytical approaches, football performance can now be evaluated using advanced indicators such as expected goals (xG), expected assists (xA), pressing intensity, progressive passing, transition efficiency, possession sequences, spatial occupation, and defensive compactness (Castellano et al., 2024).

The scientific foundations of football performance analysis were established through early investigations focused on technical efficiency, passing sequences, and tactical organization in elite football (Hughes & Bartlett, 2002; Hughes & Franks, 2005). These pioneering studies demonstrated the importance of systematic observation in understanding successful football performance and represented the basis for modern notational analysis methodologies currently used in professional football environments.

Within Croatian sports science, significant contributions to football analysis and kinesiology research were provided by Goran Sporiš and collaborators. Early research conducted by Sporiš emphasized the importance of football match analysis in the planning and programming of physical preparation processes in elite football environments (Sporiš, 2003). Furthermore, Sporiš and colleagues investigated conditioning preparation, injury prevention, and applied kinesiology models relevant to football performance optimization (Mihačić et al., 2003; Sporiš & Tomić, 2004).



Figure 1. Framework of the notational analysis in the Croatian First Football League (SuperSport HNL) 2025/2026 season.

Recent scientific literature increasingly emphasizes the importance of probabilistic and contextual models in football analytics. Contemporary studies demonstrated that expected goals metrics possess significantly stronger predictive validity for match outcomes than traditional variables such as total shots or possession percentage alone (Liu et al., 2025). Furthermore, modern football analysis increasingly integrates tactical and positional data with physical performance indicators, enabling multidimensional interpretation of team behaviour during offensive and defensive phases of play (Fernandez-Navarro et al., 2024).

The tactical evolution of football during recent seasons has been strongly characterized by high-intensity pressing systems, compact defensive organization, vertical attacking transitions, and rapid ball recoveries in advanced field zones. Elite teams competing in UEFA competitions increasingly rely on coordinated pressing structures designed to disrupt opposition build-up phases and create transitional attacking opportunities (Bradley & Ade, 2024). Tactical analyses from recent European competitions further demonstrated that successful teams perform greater numbers of high-intensity defensive actions while simultaneously maintaining superior positional organization during possession phases (Clemente et al., 2025).

Another increasingly important area within football analytics involves possession-sequence analysis and transition efficiency. Recent investigations reported that successful teams demonstrate significantly greater efficiency during offensive transition phases and create higher-quality scoring opportunities through progressive passing and positional superiority (Sarmiento et al., 2024). Similarly, studies focusing on elite football demonstrated that tactical efficiency in transition phases may represent one of the strongest determinants of successful match outcomes in contemporary football (Goes et al., 2025).

In addition to offensive tactical indicators, current literature highlights the growing importance of defensive compactness and coordinated pressing behaviour. Teams capable of reducing effective playing space and applying synchronized pressure on opponents demonstrate significantly greater defensive efficiency and lower expected goals conceded (Memmert & Rein, 2024). Moreover, recent studies suggest that modern football success is increasingly determined by collective tactical synchronization rather than isolated technical performance variables (Dellal et al., 2024).

The influence of contextual variables such as match location, opposition quality, scoreline, and competition phase has also become an important research focus in football performance analysis. Previous investigations demonstrated that home teams generally achieve greater offensive efficiency, possession dominance, and tactical initiative compared to away teams (Lago-Peñas et al., 2024). Furthermore, elite teams competing in domestic and European competitions frequently adapt tactical structures according to situational and contextual demands during matches.

Although extensive research has examined the English Premier League, UEFA Champions League, Bundesliga, La Liga, and Serie A, relatively few studies have focused on the Croatian First Football League (SuperSport HNL). Given the growing international visibility of Croatian football, including regular participation in UEFA competitions and the continued development of elite international players, comprehensive scientific analysis of its tactical and technical characteristics is increasingly needed.

The Croatian football environment represents an especially interesting research context due to its tactical diversity, developmental structures, and increasing tactical modernization influenced by contemporary European football trends. Despite these developments, scientific literature addressing notational analysis in SuperSport HNL remains scarce, particularly regarding modern analytical indicators such as expected goals, pressing efficiency, transition organization, and tactical compactness.

Therefore, the primary aim of this study was to conduct a comprehensive notational analysis of the Croatian First Football League during the 2025/2026 season and identify the key technical and tactical indicators associated with successful competitive performance. Additionally, the study aimed to examine the relationships between expected goals metrics, possession-based indicators, pressing structures, offensive transitions, and match outcomes in Croatian elite football.

Conceptual framework

Contextual variables (home advantage, match status, opposition quality) influence tactical organization (pressing, compactness, transitions), which affects offensive production quality (xG, shots, final-third entries) and ultimately match success.

This investigation represents one of the first comprehensive analytical mappings of Croatian elite football integrating sports analytics, machine learning, performance modelling, and applied artificial intelligence approaches.

This investigation additionally contributes to the emerging fields of sports analytics, data science, predictive modelling, machine learning, and applied artificial intelligence in sport.

To our knowledge, this study represents one of the first comprehensive analytical mappings of Croatian elite football integrating traditional performance indicators, expected goals metrics, tactical variables, contextual factors, and predictive modelling approaches.

METHODS

Study design

This study employed a retrospective observational research design based on systematic notational analysis of matches played during the 2025/2026 SuperSport HNL season. The investigation was conducted using quantitative performance analysis methods commonly applied in elite football research. Technical, tactical, and situational variables were collected and analysed to determine their relationship with successful competitive performance.

The study followed methodological principles previously applied in elite football analytics research involving performance indicators, expected goals models, tactical transitions, and contextual match variables (Castellano et al., 2024; Clemente et al., 2025).

Sample and match selection

The sample consisted of all official matches played during the 2025/2026 SuperSport HNL competitive season. A total of 180 matches involving all participating teams were included in the analysis.

Inclusion criteria:

- Official league matches only.
- Full match statistical availability.
- Availability of video recordings and event data.
- Matches completed without interruption.

Exclusion criteria:

- Abandoned matches.

- Matches with incomplete tracking data.
- Matches with corrupted event statistics.

The observational units included both team-level and match-level performance indicators.

Data sources and data collection

Match data were obtained from:

- Official SuperSport HNL statistical databases.
- Wyscout performance platform.
- Opta event data.
- Video recordings of all analysed matches.
- Tactical coding performed by licensed performance analysts.

All matches were independently coded by two experienced analysts trained in football notational analysis procedures. Inter-observer reliability was assessed using Cohen's Kappa coefficient.

The reliability analysis demonstrated excellent agreement:

- Technical variables: $\kappa = 0.91$.
- Tactical variables: $\kappa = 0.88$.
- Transition coding: $\kappa = 0.86$.
- Pressing sequences: $\kappa = 0.84$.

Values above $\kappa = 0.80$ were considered highly reliable according to contemporary sports performance analysis standards.

Variables

Technical variables

The following technical indicators were analysed:

- Total passes.
- Successful passes.
- Passing accuracy (%).
- Progressive passes.
- Crosses.
- Successful dribbles.
- Total shots.
- Shots on target.
- Goals scored.
- Expected goals (xG).
- Expected assists (xA).
- Set-piece efficiency.

Tactical variables

The following tactical indicators were observed:

- Ball possession (%).
- Possession sequences.

- Final-third entries.
- Counter-attacks.
- Offensive transitions.
- Defensive transitions.
- Pressing intensity.
- PPDA (Passes Allowed Per Defensive Action).
- High pressing recoveries.
- Defensive compactness.
- Width and depth occupation.
- Build-up organization.

Defensive variables

- Duels won.
- Interceptions.
- Tackles.
- Defensive recoveries.
- Clearances.
- Blocks.
- xG conceded.
- Pressing success rate.

Contextual variables

- Match location (home/away).
- Match outcome (win/draw/loss).
- Opposition ranking.
- Match status.
- Score differential.
- Competition phase.

Operational definitions

Expected goals (xG) represented the probability of a shot resulting in a goal based on shot location, shot angle, body part used, defensive pressure, and assist type.

Pressing intensity was measured using PPDA methodology, representing the number of opposition passes allowed before a defensive action occurred.

Offensive transition was operationally defined as a rapid attacking sequence initiated within eight seconds following ball recovery.

Defensive compactness referred to the average horizontal and vertical team dispersion during out-of-possession phases.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics 29.0 and R statistical software.

Descriptive statistics

Descriptive statistical parameters included:

- Arithmetic mean (M).
- Standard deviation (SD).
- Minimum values.
- Maximum values.
- Coefficient of variation (CV).
- 95% confidence intervals (CI).

Normality testing

The normality of data distribution was evaluated using:

- Shapiro–Wilk test.
- Kolmogorov–Smirnov test.
- Q-Q plots.
- Skewness and kurtosis coefficients.

Variables demonstrating non-normal distribution were transformed using logarithmic normalization procedures when necessary.

Inferential statistics

Independent samples t-tests were used to determine differences between:

- Winning vs. losing teams.
- Home vs. away teams.
- Top-ranked vs. bottom-ranked teams.

One-way ANOVA analyses with Bonferroni post hoc correction were applied to compare:

- Match outcomes.
- Tactical efficiency groups.
- Possession categories.

Repeated measures ANOVA was used to evaluate tactical changes across different match periods.

Effect size analysis

Effect sizes were calculated using:

- Cohen's d.
- Partial eta squared (η^2).
- Odds ratios (OR).

Effect sizes were interpreted according to established guidelines:

- Small effect: $d = 0.20$.
- Moderate effect: $d = 0.50$.
- Large effect: $d \geq 0.80$.

Correlation analysis

Pearson and Spearman correlation coefficients were used to evaluate relationships between:

- xG and match outcome.

- Possession and offensive efficiency.
- Pressing intensity and ball recoveries.
- Passing accuracy and league ranking.

Correlation strength interpretation:

- Weak: $r < .30$.
- Moderate: $r = .30 - .49$.
- Strong: $r \geq .50$.

Regression models

Multiple linear regression analysis was conducted to identify predictors of:

- Match success.
- League ranking.
- Offensive efficiency.
- Defensive stability.

Logistic regression models were additionally constructed to estimate probabilities of match victory based on tactical and technical variables.

Multicollinearity diagnostics included (multicollinearity diagnostics revealed acceptable values for all predictors ($VIF < 5$), indicating no problematic multicollinearity):

- Variance Inflation Factor (VIF).
- Tolerance values.
- Durbin-Watson statistics.

Machine learning analysis

Machine learning workflow: models were trained using an 80:20 train-test split, validated using stratified five-fold cross-validation, and optimized using hyperparameter tuning procedures. Feature selection and out-of-sample validation were applied.

Advanced predictive analysis was conducted using:

- Random Forest models.
- Decision Tree analysis.
- Gradient Boosting models.

Predictive accuracy was evaluated through:

- ROC curves.
- Area Under the Curve (AUC).
- Precision-recall metrics.
- Cross-validation procedures.

Significance threshold

Statistical significance was established at: $p < .05$. Highly significant findings were reported at: $p < .01$ and $p < .001$.

Table 1. Multicollinearity diagnostics (Variance Inflation Factor, VIF) for predictor variables included in the regression models.

Variable	VIF
xG	2.11
Passing accuracy	1.89
PPDA	2.34
High pressing recoveries	1.97
Final-third entries	2.28

Ethical considerations

The study utilized publicly available match data and observational performance analysis without involving direct athlete intervention. Therefore, formal ethical approval was not required according to institutional guidelines for observational sports analytics research. All procedures were conducted in accordance with the ethical standards of sports science research and the Declaration of Helsinki.

RESULTS

Descriptive analysis of match performance indicators

A total of 180 matches from the 2025/2026 SuperSport HNL season were included finally. The dataset consisted of 360 team-match observations, representing both home and away team performances. Across all analysed matches, the average number of goals per match was 2.61 ± 1.34 , while the mean expected goals value per team was 1.32 ± 0.64 .

The average ball possession per team was $50.0 \pm 8.7\%$, with substantial differences observed between higher-ranked and lower-ranked teams. Teams positioned in the upper part of the league table demonstrated greater possession control, higher passing accuracy, more final-third entries, and superior expected goals production compared with lower-ranked teams.

Winning teams achieved higher values in nearly all offensive and tactical indicators compared with drawing and losing teams. The largest differences were observed in expected goals, shots on target, final-third entries, progressive passes, and pressing recoveries.

Match outcome differences

When performance indicators were analysed according to match outcome, winning teams demonstrated significantly greater offensive efficiency compared with losing teams.

Winning teams recorded higher ball possession ($57.8 \pm 6.9\%$) than drawing teams ($50.6 \pm 7.4\%$) and losing teams ($44.3 \pm 7.1\%$). One-way ANOVA showed a statistically significant difference between groups, $F(2,357) = 28.41$, $p < .001$, $\eta^2 = 0.14$. Bonferroni post hoc analysis confirmed significant differences between winning and losing teams, as well as between winning and drawing teams.

Passing accuracy also differed significantly between match outcome groups. Winning teams achieved an average passing accuracy of $84.9 \pm 4.1\%$, drawing teams $80.7 \pm 4.8\%$, and losing teams $76.8 \pm 5.2\%$. The difference was statistically significant, $F(2,357) = 31.76$, $p < .001$, $\eta^2 = 0.15$.

Expected goals represented one of the strongest differentiating variables. Winning teams produced significantly higher xG values (2.04 ± 0.58) compared with drawing teams (1.21 ± 0.43) and losing teams

(0.86 ± 0.37), $F(2,357) = 46.92$, $p < .001$, $\eta^2 = 0.21$. This indicates that successful teams were not only more frequent in shot production but also created higher-quality goal-scoring opportunities.

Offensive performance indicators

Winning teams produced an average of 15.4 ± 3.6 total shots per match, compared with 11.2 ± 3.1 among drawing teams and 8.7 ± 2.9 among losing teams. Shots on target followed a similar pattern, with winning teams recording 6.8 ± 1.9 shots on target, drawing teams 4.2 ± 1.5 , and losing teams 2.9 ± 1.3 .

Final-third entries were significantly higher among successful teams. Winning teams entered the final third 52.6 ± 9.8 times per match, while losing teams recorded 34.9 ± 8.2 final-third entries. Progressive passes were also more frequent among winning teams, suggesting superior vertical ball progression and more effective positional play.

Set-piece efficiency represented an additional important offensive indicator. Approximately 26.8% of all goals were scored following set-piece situations, including corners, indirect free kicks, direct free kicks, and second-ball situations after dead-ball phases. Top-ranked teams demonstrated greater set-piece conversion efficiency compared with lower-ranked teams.

Defensive and pressing indicators

Defensive performance indicators revealed that successful teams were more effective in regaining possession in advanced zones. Winning teams recorded significantly more high pressing recoveries (9.7 ± 2.8) than drawing teams (6.4 ± 2.2) and losing teams (4.8 ± 1.9), $F(2,357) = 24.13$, $p < .001$, $\eta^2 = 0.12$.

PPDA values were lower among successful teams, indicating higher pressing intensity. Winning teams demonstrated an average PPDA of 8.9 ± 2.1 , compared with 11.7 ± 2.6 for drawing teams and 14.2 ± 3.1 for losing teams. Lower PPDA values were moderately associated with higher final-third recoveries and improved attacking transition efficiency.

Defensive compactness also differed between groups. Teams finishing in the top four league positions maintained lower average vertical and horizontal dispersion during defensive phases, suggesting more coordinated collective defensive behaviour. These teams also conceded lower xG values, indicating superior defensive structure and shot prevention.

Home and away performance

Home teams demonstrated a measurable performance advantage across several variables. Home teams won 52.2% of analysed matches, away teams won 28.9%, while 18.9% of matches ended in a draw.

Home teams recorded higher average possession ($53.4 \pm 7.8\%$) compared with away teams ($46.6 \pm 8.1\%$), $t(358) = 6.42$, $p < .001$. Home teams also produced more total shots, shots on target, and final-third entries.

Expected goals were higher for home teams (1.51 ± 0.61) compared with away teams (1.13 ± 0.54), $t(358) = 5.87$, $p < .001$. This finding indicates that home advantage was not only reflected in match outcome but also in chance quality and attacking production.

Correlation analysis

Correlation analysis revealed several meaningful relationships between tactical and technical indicators.

Expected goals showed the strongest association with match outcome, $r = .61$, $p < .001$. Shots on target were also strongly correlated with match success, $r = .58$, $p < .001$. Passing accuracy demonstrated a moderate-to-strong correlation with league ranking, $r = 0.52$, $p < .001$.

High pressing recoveries were positively correlated with xG production, $r = .47$, $p < .001$, suggesting that successful pressing frequently created high-quality attacking opportunities. PPDA was negatively correlated with match success, $r = -.49$, $p < .001$, confirming that lower PPDA values were associated with better competitive outcomes.

Ball possession showed a moderate correlation with match success, $r = .38$, $p < .01$, indicating that possession alone was not sufficient to explain performance success unless combined with progression, chance creation, and pressing efficiency.

Regression analysis

Multiple linear regression analysis was conducted to identify predictors of match success. The final model explained 48.6% of variance in match success, $R^2 = .486$, adjusted $R^2 = .472$, $F(6,353) = 34.21$, $p < .001$.

The strongest predictors of match success were:

- Expected goals: $\beta = 0.42$, $p < .001$.
- Shots on target: $\beta = 0.31$, $p < .001$.
- High pressing recoveries: $\beta = 0.24$, $p = .004$.
- Passing accuracy: $\beta = 0.21$, $p = .009$.
- Final-third entries: $\beta = 0.19$, $p = .013$.

Ball possession was not a significant independent predictor when xG, pressing, and shot quality variables were included in the model, $\beta = 0.08$, $p = .117$. This suggests that the effectiveness of possession was more important than possession volume itself.

Logistic regression model

Binary logistic regression was used to estimate the probability of winning a match. The model correctly classified 76.4% of match outcomes.

The odds of winning increased significantly when a team achieved:

- xG above 1.75: OR = 3.84, 95% CI = 2.21–6.67, $p < .001$.
- At least 5 shots on target: OR = 3.12, 95% CI = 1.88–5.19, $p < .001$.
- More than 8 high pressing recoveries: OR = 2.46, 95% CI = 1.41–4.29, $p = .002$.
- Passing accuracy above 83%: OR = 2.18, 95% CI = 1.29–3.68, $p = .004$.

These findings suggest that match victory in the SuperSport HNL was most strongly associated with high-quality chance creation, offensive precision, pressing success, and technical consistency.

Machine learning prediction

Random Forest analysis was used to identify the most important performance variables for predicting match outcome. The model achieved an overall prediction accuracy of 79.1%, with an AUC value of 0.82. Although predictive performance was promising, external validation on independent datasets is recommended to minimize potential overfitting and improve model generalizability.

The most important predictors were:

- Expected goals.
- Shots on target.
- Final-third entries.
- High pressing recoveries.
- PPDA.
- Passing accuracy.
- Progressive passes.
- xG conceded.
- Set-piece efficiency.
- Ball possession.

The model confirmed that chance quality and pressing-related variables were more influential than simple possession measures.

Summary of key findings

The results demonstrated that successful teams in the Croatian First Football League were characterized by superior chance creation, higher expected goals values, greater passing accuracy, more effective pressing, and increased final-third presence.

The most important performance predictors were expected goals, shots on target, high pressing recoveries, and passing accuracy. Possession was relevant but not independently decisive unless accompanied by progressive passing and attacking efficiency.

Overall, the findings suggest that competitive success in the SuperSport HNL is increasingly determined by multidimensional tactical efficiency, including high-quality attacking production, coordinated pressing, defensive compactness, and effective transition play.

DISCUSSION

The primary aim of this study was to conduct a comprehensive notational analysis of the Croatian First Football League (SuperSport HNL) during the 2025/2026 season and identify the technical and tactical performance indicators most strongly associated with successful competitive outcomes. The findings demonstrated that successful teams consistently achieved superior values across multiple offensive, defensive, and tactical dimensions, particularly regarding expected goals production, passing efficiency, high pressing recoveries, and offensive transition organization.

Unlike several major European leagues characterized by prolonged possession phases, Croatian elite football appears to rely more strongly on:

- Vertical progression,
- Transition efficiency,
- Coordinated pressing,
- Tactical compactness,
- Rapid attacking organization.

One of the most important findings of the present investigation was the strong relationship between expected goals (xG) and match success. Teams generating higher xG values achieved significantly greater competitive success, indicating that the quality of scoring opportunities was substantially more important than the simple quantity of shots performed during matches. This finding strongly supports recent football analytics literature emphasizing the predictive superiority of xG-based models compared with traditional statistical indicators (Liu et al., 2025). Contemporary probabilistic models increasingly demonstrate that xG represents one of the most reliable indicators of attacking efficiency and long-term team performance stability in elite football competitions.

Furthermore, the present study demonstrated that shots on target and final-third entries were strongly associated with successful outcomes. Winning teams produced significantly greater offensive penetration and attacking continuity, indicating superior positional organization and more efficient progression through offensive phases of play. Similar findings were reported by Sarmiento et al. (2024), who emphasized the importance of offensive transition quality and vertical progression in elite football environments. The results additionally support the observations of Castellano et al. (2024), who identified offensive territorial dominance and advanced field occupation as key characteristics of successful professional football teams.

Passing accuracy also emerged as a highly significant performance indicator. Teams achieving higher passing efficiency demonstrated greater tactical control, superior positional structure, and increased competitive stability throughout matches. These findings align with previous investigations conducted within elite European competitions, where successful teams consistently demonstrate superior technical precision and possession stability (Almeida et al., 2024). However, the present findings additionally suggest that possession effectiveness was more important than possession volume itself. Although winning teams generally demonstrated higher possession percentages, possession alone was not an independent predictor of success within regression models once xG, pressing intensity, and attacking efficiency variables were included.

This observation reflects the broader tactical evolution of contemporary football. Modern elite football increasingly prioritizes vertical progression, positional superiority, and transition effectiveness rather than passive possession accumulation. Similar tactical trends were described by Fernandez-Navarro et al. (2024), who reported that modern successful teams utilize possession primarily as a mechanism for spatial manipulation and progression rather than simple territorial control.

The present study also demonstrated that pressing-related variables represented some of the strongest determinants of successful match outcomes. Winning teams performed significantly more high pressing recoveries and maintained substantially lower PPDA values compared with unsuccessful teams. These findings indicate that aggressive pressing organization and coordinated defensive pressure played an essential role within contemporary Croatian elite football.

Recent football literature increasingly emphasizes the strategic importance of pressing systems in elite competitions (Clemente et al., 2025). Coordinated pressing structures enable teams to disrupt opposition build-up phases, reduce opponent progression time, and create advantageous offensive transitions immediately following ball recovery. The current findings support the conclusions of Bradley and Ade (2024), who demonstrated that elite football increasingly depends on high-intensity coordinated tactical behaviours during defensive and transition phases.

Additionally, the relationship observed between high pressing recoveries and expected goals production further highlights the growing integration between defensive organization and offensive efficiency in modern football. Teams capable of regaining possession in advanced zones generated significantly higher-quality scoring opportunities, suggesting that defensive pressing structures now directly contribute to attacking production rather than functioning solely as defensive mechanisms.

The findings regarding defensive compactness additionally support recent theoretical frameworks emphasizing collective tactical synchronization. Teams positioned in the upper part of the league table demonstrated significantly lower horizontal and vertical dispersion during defensive phases, indicating superior collective organization and spatial control. Similar observations were reported by Memmert and Rein (2024), who identified defensive compactness as one of the central determinants of shot prevention and defensive efficiency in elite football environments.

The concept of collective synchronization was further supported by the findings of Dellal et al. (2024), who argued that modern football success increasingly depends on coordinated collective tactical behaviours rather than isolated individual technical quality. The present results strongly support this perspective, as successful teams consistently demonstrated greater organizational coherence during offensive progression, defensive transitions, and pressing phases.

Another important finding involved the influence of home advantage. Home teams demonstrated significantly higher offensive production, greater xG values, and increased tactical initiative compared with away teams. These results align with extensive previous literature demonstrating the influence of contextual variables on football performance (Lago-Peñas et al., 2024). Home environments may provide psychological, motivational, environmental, and tactical advantages that facilitate greater attacking confidence and territorial dominance.

Contextual dynamics analysis suggests that home advantage interacts with tactical initiative, pressing intensity, and offensive production, highlighting the importance of situational tactical adaptation.

Within the context of Croatian football specifically, the findings suggest that tactical modernization within SuperSport HNL increasingly reflects broader European tactical trends. Croatian elite football appears progressively characterized by (compared with major European leagues, Croatian football appears to rely more heavily on vertical progression, transition efficiency, tactical compactness, and coordinated pressing structures):

- Organized pressing systems,
- Structured positional play,
- Vertical attacking transitions,
- Tactical compactness,
- Increased analytical optimization.

These developments may partially explain the growing international competitiveness of Croatian clubs and players within UEFA competitions and European football markets.

An especially important theoretical contribution of the present study relates to the integration of traditional notational analysis with modern performance analytics frameworks. Historically, football match analysis primarily focused on descriptive variables such as shots, possession, and passes (Hughes & Bartlett, 2002; Hughes & Franks, 2005). However, contemporary football increasingly requires multidimensional

interpretation integrating tactical, positional, probabilistic, and contextual indicators simultaneously. The present investigation contributes to this growing analytical paradigm by combining expected goals metrics, pressing variables, transition indicators, and contextual tactical behaviours within a unified performance model.

Within Croatian sports science, the present findings also extend the applied football research tradition established by Goran Sporiš and collaborators. Early investigations by Sporiš emphasized the importance of integrating match analysis with conditioning preparation and tactical planning processes in football environments (Sporiš, 2003). Furthermore, Sporiš and colleagues highlighted the necessity of applying scientific methodology to football performance optimization and injury prevention (Mihačić et al., 2003; Sporiš & Tomić, 2004). The current investigation expands these foundational approaches through the integration of contemporary analytical indicators such as xG, PPDA, pressing recoveries, and predictive statistical modelling.

The practical implications of the study are substantial for coaches, analysts, conditioning specialists, and football organizations operating within Croatian elite football. The findings suggest that training methodologies should increasingly emphasize:

- Coordinated pressing organization,
- Transition efficiency,
- Progressive passing structures,
- Attacking spatial occupation,
- Defensive compactness,
- High-quality chance creation.

Moreover, football clubs may benefit from integrating advanced analytical systems and performance modelling into tactical preparation, opposition scouting, recruitment strategies, and player development processes.

Several limitations should nevertheless be acknowledged. First, the study analysed only a single competitive season, limiting long-term trend interpretation. Second, although advanced event and tactical indicators were included, full spatiotemporal positional tracking data were not available for all matches. Third, physiological variables such as sprint load, acceleration profiles, and fatigue indicators were not incorporated into the current analytical framework.

Additional limitations include the absence of player-level analysis, positional tracking data, tactical network analysis, and tactical micro-structure evaluation.

Future investigations should therefore examine longitudinal tactical evolution across multiple seasons while integrating positional tracking systems, machine learning approaches, biomechanical variables, and contextual tactical models. Additionally, future studies should investigate individual player networks, tactical adaptability, and opponent-specific strategic behaviours within Croatian elite football environments.

Future studies should integrate tracking systems, player interaction networks, biomechanical variables, artificial intelligence models, and longitudinal multi-season analyses.

Overall, the present investigation contributes to the growing scientific literature regarding football notational analysis and represents one of the more comprehensive analytical examinations of the Croatian First Football

League currently available. The findings demonstrate that competitive success within SuperSport HNL is increasingly determined by multidimensional tactical efficiency involving offensive precision, coordinated pressing systems, transition effectiveness, and collective tactical synchronization.

The findings have broader global applicability and support the ongoing tactical evolution of elite football toward multidimensional performance optimization.

The findings of the present study extend beyond Croatian football and support broader tactical trends observed in elite football worldwide. The increasing importance of expected goals, coordinated pressing, and transition efficiency appears to represent a universal characteristic of contemporary football performance.

AUTHOR CONTRIBUTIONS

All authors meet the criteria for authorship in accordance with established ethical guidelines. Contributions are specified according to the CRediT (Contributor Roles Taxonomy) as follows: Conceptualisation: Boriss Bazanov, Ivica Franjko, Veljko Vukicevic. Methodology: Maki Grle, Goran Sporiš, Besnik Morina, Milna Milošević. Formal analysis: Davorin AntoniĆ. Investigation: Ernest Šabić, Davor Lješević, Fredi Fiorentini, Zeljko Kovačević. Data curation: Naim Ćeleš, Davorin AntoniĆ, Ivan Duroci, Hrvoje Ajman, Zeljko Širić. Writing – original draft: Ivana Grle, Goran Sporiš, Bozenka Galic Tiric. Writing – review & editing: Nijaz Skender, Jerko Prlić, Ahmet Naci Dilek, Adem Preljević. Supervision: Goran Sporiš, Dejan Tiric, Natalija Kurtović.

All authors have critically reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this manuscript.

ETHICAL APPROVAL

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AI USE DISCLOSURE

In accordance with current publishing ethics and transparency recommendations, artificial intelligence (AI) tools were used solely to assist with translation and language editing, with the aim of improving clarity and readability. No AI tools were used in the generation of scientific content, including the study design, data collection, analysis, interpretation of results, or the formulation of conclusions. The authors retain full responsibility for the content of the manuscript and confirm its originality, integrity, and accuracy.

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