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Strategic Influence of Penalty Corner Conversion Efficiency on Competitive Success in Elite Men's Indoor Hockey: Performance Analytics from the 2025 Southeast Asian Games

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Muhammad Hendri Firdaus[*1abcde], **Achmad Widodo**[1bc], **Himawan Wismanadi**[1ce], **Taufiq Hidayat**[1abc], **Pudjijuniarto**[1bcd], **Heryanto Nur Muhammad**[1cd]

[1]Faculty of Sports and Health Sciences, State University of Surabaya, Indonesia.

ABSTRACT

The purpose of the study. This study examined the strategic influence of penalty corner conversion efficiency on competitive success in elite men's indoor hockey during the 2025 Southeast Asian (SEA) Games. The study was designed to determine whether team-level penalty corner productivity was associated with match victories and final ranking outcomes in a compressed international tournament environment.

Materials and methods. A retrospective quantitative performance analytics design was employed. The units of analysis were the five national men's indoor hockey teams participating in the official tournament, with performance indicators extracted from all 13 official fixtures, including preliminary, semifinal, and medal-round matches. The principal explanatory variable was total penalty corner goals, whereas competitive success was operationalized through total victories and final tournament ranking. Descriptive statistics, Shapiro-Wilk normality testing, Pearson and Spearman correlations, and simple linear regression were used to evaluate distributional properties, bivariate associations, and predictive strength.

Results. Penalty corner productivity showed a very strong positive association with total team victories ($r = .943$, $p = .016$) and final ranking position ($rho = .949$, $p = .014$). Regression analysis indicated that penalty corner goals significantly predicted competitive success, accounting for 88.9% of the variance in team performance ($R2 = .889$, $beta = .943$, $p = .016$).

Conclusions. Penalty corner conversion efficiency appears to be a decisive tactical determinant of elite men's indoor hockey success in the 2025 SEA Games context. The findings support the integration of specialized set-piece preparation, opponent-specific video analysis, and evidence-informed tactical planning within national indoor hockey programs. Given the small number of participating teams, the results should be interpreted as high-value tournament evidence rather than a universally generalizable model.

Keywords: indoor hockey; penalty corner; performance analytics; set-piece efficiency; tactical analysis; SEA Games; elite sport.

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EDITED BY
Dr. Eneng Fitri Amalia, M.Pd
Physical Education, Universitas Suryakancana, Indonesia.

Dr. Benny Aprial, M.Pd
Physical Education, Health, and Recreation, Universitas Pembinaan Masyarakat Indonesia.

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INTRODUCTION

Contemporary elite team sports are increasingly shaped by the capacity to transform structured tactical moments into

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Corresponding Author: Muhammad Hendri Firdaus, e-mail: muhammadhendri.23004@mhs.unesa.ac.id

measurable competitive advantage (Augste & Prestel, 2021). In invasion games, where spatial pressure, opponent density, and temporal constraints limit the frequency of high-quality scoring opportunities, set-pieces have become an essential performance domain (González-Ródenas et al., 2017; Strafford et al., 2019). Hockey is a particularly compelling case because penalty corners combine technical precision, tactical deception, perceptual speed, and collective coordination within a highly compressed time window (Laird & Sutherland, 2003; Morris-Binelli et al., 2020). For attacking teams, penalty corners create one of the most controllable routes to goal; for defending teams, they represent a recurrent crisis situation requiring rapid anticipation, disciplined positioning, and coordinated goalkeeper-defender interaction.

Indoor hockey intensifies these demands. Compared with the outdoor game, the indoor format is played on a smaller court with fewer players, faster ball circulation, shorter decision-making intervals, and reduced tolerance for technical error (Fernández et al., 2021). These features elevate the relative importance of set-piece quality, because open-play attacks are often disrupted by compact defensive structures and limited space around the shooting circle (Stone et al., 2021). Consequently, a team's capacity to convert penalty corners may not simply reflect isolated technical ability but may also signal deeper competitive qualities: tactical preparation, executional stability, specialist skill development, and the integration of performance analysis into training design.

The Southeast Asian Games offer a distinctive regional laboratory for examining these relationships. The event brings together national programs with different developmental histories, tactical cultures, and resource environments, while the short tournament schedule magnifies the consequences of small performance margins (Gómez-Rodríguez et al., 2024). In such contexts, a single penalty corner goal can alter match momentum, group positioning, and medal outcomes. Uannderstanding how penalty corner productivity relates to competitive success in elite men's indoor hockey is therefore relevant not only for match alysis but also for strategic planning, coaching education, and national high-performance policy.

Critical Examination of Existing Literature

The performance analysis literature in hockey has established that penalty corners are among the most strategically valuable scoring situations. Moon et al. (2018) demonstrated that tactical structure, shot location, and execution choice can differentiate successful from unsuccessful penalty corner attacks in international hockey. Their findings are important because they shift attention away from the penalty corner as a single shooting event and toward a coordinated sequence involving injection, stopping, deception, finishing, and defensive response (Morris-Binelli et al., 2020; Vasiljev et al., 2020). This interpretation is consistent with broader performance analysis perspectives suggesting that effective hockey analysis must account for interactions among players, opponents, spatial constraints, and tactical context rather than treating match events as isolated frequencies (Lord et al., 2021).

Research on the defensive side of penalty corners further underscores the complexity of this performance domain. Morris-Binelli et al., (2020) showed that international goalkeepers and coaches consider psycho-perceptual-motor skills critical for saving penalty corner drag-flicks, particularly because goalkeepers must extract advance information from the injector, stopper, and shooter before the ball reaches the goal. Complementary work on visual skills in field hockey has also emphasized saccadic control, peripheral awareness, visual reaction time, and hand-eye coordination as important capacities for managing fast, crowded, and uncertain ball trajectories (Sneyimani et al., 2023; Wimshurst et al., 2012). Together, these studies indicate that penalty corner outcomes are produced by a combination of biomechanical proficiency, tactical patterning, perceptual anticipation, and psychological stability under pressure.

Cross-sport evidence strengthens the theoretical relevance of set-piece and special-situation efficiency. In water polo, power-play conversion has been shown to contribute meaningfully to match productivity and goal differential (Gullikson et al., 2023; Perazzetti et al., 2023), while elite match analysis has demonstrated that advantage situations often distinguish stronger from weaker competitive performances (Borges-Hernández et al., 2022; Lupo et al., 2025). In beach handball, notational analysis has been used to translate shooting patterns into coaching-relevant tactical decisions (Iannaccone et al., 2020). In ice hockey, league- and context-specific shooting profiles have been shown to provide practical benchmarks for tactical preparation (Csiernik et al., 2025). Although these sports differ from indoor hockey, they collectively support the proposition that structured or numerically advantageous situations can exert disproportionate influence on competitive outcomes.

Despite these contributions, existing hockey scholarship remains uneven. Much of the available evidence concerns outdoor hockey, women's competitions, or general match-event profiling rather than elite men's indoor hockey in Southeast Asia. Moreover, while global studies have begun comparing formats and documenting differences in hockey match events (West et al., 2025), the indoor version remains comparatively underrepresented in empirical performance analytics. This underrepresentation is problematic because tactical conclusions derived from outdoor hockey cannot be transferred uncritically to indoor hockey, where court geometry, rules, player density, and transition speed produce different performance constraints.

Identification of Research Gaps

Four gaps are particularly relevant. First, there is limited empirical evidence quantifying the relationship between penalty corner productivity and competitive success in elite men's indoor hockey. Second, the Southeast Asian Games context has rarely been used as a performance analytics setting, despite its importance for regional high-performance development. Third, existing studies have often analyzed penalty corner technique or tactical variation without explicitly linking these indicators to tournament-level outcomes such as wins and rankings. Fourth, the small but strategically meaningful nature of international indoor tournaments requires analytical approaches that can extract interpretable evidence from compact datasets while acknowledging limits to generalizability.

These gaps restrict the ability of coaches, analysts, and sport administrators to identify which performance indicators deserve priority in training and competition planning. In particular, national programs require evidence that clarifies whether investment in specialist penalty corner routines, drag-flick development, defensive scouting, and video-based tactical variation is likely to translate into competitive advantage. Without such evidence, set-piece preparation may remain dependent on coaching intuition rather than

systematic performance intelligence.

Rationale for the Research

The rationale for the present study rests on the strategic nature of penalty corners and the competitive structure of the SEA Games. Indoor hockey tournaments are often decided by narrow margins, and structured scoring opportunities can substantially alter the probability of winning. Penalty corner conversion efficiency therefore represents a practical and theoretically meaningful variable for explaining team success. By examining official tournament data from the 2025 SEA Games, the study provides context-specific evidence for a region in which indoor hockey is developing competitively but remains underrepresented in peer-reviewed performance analytics.

The study also contributes methodologically by demonstrating how a compact tournament dataset can be analyzed through transparent descriptive, correlational, and regression procedures. Rather than claiming universal prediction, the analysis aims to establish whether penalty corner productivity functioned as a decisive tactical marker within this specific elite tournament. This approach aligns with the applied orientation of modern sport analytics, where evidence is most valuable when it can inform coaching decisions, performance review, and future scouting priorities.

Objectives

The objectives of this study are to quantify team-level penalty corner productivity among elite men's indoor hockey teams competing at the 2025 SEA Games and to examine its association with match victories and final tournament ranking. Specifically, this study seeks to determine the extent to which penalty corner productivity predicts competitive success within the tournament sample. In addition, the findings are interpreted in relation to contemporary hockey performance analysis and set-piece specialization literature. Finally, this study aims to formulate practical coaching and performance analytics implications that may support elite indoor hockey preparation, particularly in optimizing penalty corner execution as a strategic component of competitive performance.

MATERIALS AND METHODS

Study Participants

The study cohort consisted of the five national men's indoor hockey teams that participated in the official 2025 SEA Games tournament: Indonesia, Malaysia, Thailand, Singapore, and the Philippines. Because the analysis used team-level official match records, individual demographic variables such as age, height, body mass, and playing position were not collected or analyzed. The units of analysis were national teams and their aggregated tournament performance indicators. The competitive level was classified as elite regional international competition, because all teams represented national programs in a multisport event sanctioned through official hockey competition structures.

Table 1. Tournament Cohort and Analytical Units

Characteristic	Description
Competition	2025 Southeast Asian Games men's indoor hockey
Sport format	Elite men's indoor hockey
Participating teams	Indonesia, Malaysia, Thailand, Singapore, and the Philippines
Number of teams	5
Number of official matches analyzed	13
Unit of analysis	Team-level aggregated tournament performance
Primary exposure variable	Total penalty corner goals scored
Outcome variables	Total victories and final tournament ranking

Study Design and Organisation

This study used a retrospective quantitative performance analytics design. The research was observational and non-interventional, relying on official competition records and publicly available match information from the 2025 SEA Games men's indoor hockey tournament. The analytical focus was team-level performance rather than individual athlete testing. This design was appropriate because the research objective was to evaluate whether an observable match-performance indicator, penalty corner goals, was associated with competitive outcomes across the tournamen. Data were organized in three stages. First, official match records were reviewed to identify the number of penalty corner goals scored by each team across the entire tournament. Second, competitive outcomes were coded using total match victories and final ranking position. Third, all variables were compiled into a team-level analytical matrix for statistical processing. Two trained performance analysts independently checked the extracted indicators against the official records. Any discrepancies were resolved through consensus review before statistical analysis.

Penalty corner productivity was operationalized as the total number of goals scored from penalty corners by each team. Competitive success was operationalized in two complementary ways: (a) the number of match victories achieved by each team and (b) final ranking position at the conclusion of the tournament. Because ranking is ordinal, both parametric and non-parametric association measures were used to strengthen interpretive robustness.

Table 2. Operational Definition of Study Variables

Variable	Operational definition	Analytical role
Penalty corner goals	Total goals scored directly or indirectly from penalty corner situations across the tournament	Independent variable / tactical productivity indicator
Team victories	Total number of matches won by each team	Dependent variable / competitive success indicator
Final ranking position	Final placement of each team in the tournament	Dependent variable / ordinal outcome

		indicator
Regression coefficient	Standardized estimate of the relationship between penalty corner goals and team success	Predictive strength indicator
Coefficient of determination (R2)	Proportion of variance in competitive success explained by penalty corner goals	Model explanatory power

Statistical Analysis

All statistical analyses were conducted at the team level. Descriptive statistics were calculated to summarize central tendency and dispersion for penalty corner goals, victories, and final ranking position. The Shapiro-Wilk test was used to examine normality because of its suitability for small samples, although inferential interpretation was necessarily conservative given the limited number of participating teams. Pearson correlation was used to assess the linear association between penalty corner goals and team victories. Spearman rank-order correlation was used to evaluate the monotonic relationship between penalty corner goals and final ranking position because ranking is ordinal in nature. Simple linear regression was conducted to estimate the extent to which penalty corner productivity predicted competitive success. The standardized beta coefficient was interpreted as the direction and magnitude of the relationship, whereas R2 was interpreted as the proportion of outcome variance explained by penalty corner goals. Statistical significance was evaluated at alpha = .05. Given the compact tournament sample (n = 5 teams), the magnitude, direction, and practical relevance of effects were emphasized alongside p values.

Ethical Considerations

This study involved secondary analysis of official, publicly available tournament performance records and did not involve direct contact with athletes, experimental intervention, private medical information, or identifiable personal data beyond publicly reported sport performance outcomes. Nevertheless, institutional ethical endorsement is required before journal submission. Ethical approval was obtained from the [Insert Name of Institutional Ethics Committee], approval number [Insert Approval Number], on [Insert Approval Date]. If the committee determines that the study qualifies for exemption because it uses public secondary data only, the authors should replace the preceding sentence with the official exemption statement and approval/exemption reference number. All procedures should comply with institutional research integrity standards and the Declaration of Helsinki principles for responsible research reporting where applicable.

RESULTS

Descriptive Performance Patterns

Descriptive statistics were used to summarize team-level performance patterns across the elite men's indoor hockey competition. The analysis revealed substantial variation in penalty corner productivity, team victories, and final tournament ranking among the participating teams. Penalty corner goals showed a mean value of 9.60 ± 8.05, with observed values ranging from 0 to 18 goals. Team victories demonstrated a mean of 2.00 ± 1.58, ranging from 0 to 4 wins. Final ranking position had a mean of 3.00 ± 1.58, with rankings distributed from 1st to 5th place.

Table 3. Descriptive Statistics of Team Performance Variables

Variable	Mean	SD	Minimum	Maximum	Range
Penalty Corner Goals	9.60	8.05	0	18	18
Team Victories	2.00	1.58	0	4	4
Final Ranking Position	3.00	1.58	1	5	4

These findings indicate that penalty corner productivity varied considerably across teams, suggesting meaningful differences in tactical efficiency during set-piece situations.

Descriptive analysis was further supported by graphical representation to illustrate the distribution of penalty corner productivity and match victories across participating teams. Figure 1 presents a team-level comparison between penalty corner goals and match victories, allowing visual inspection of whether higher set-piece productivity was aligned with greater competitive success.

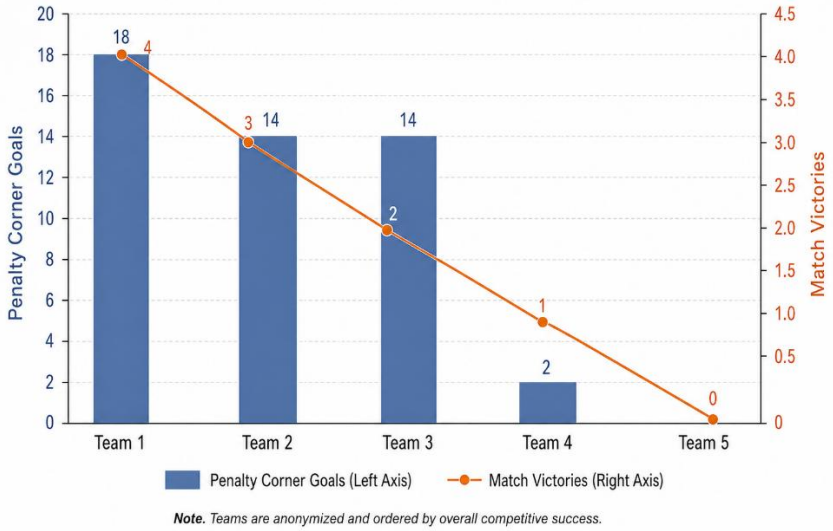


Figure 1. The figure illustrates the distribution of penalty corner goals and match victories across anonymized participating teams. Penalty corner goals are presented using the left axis, while match victories are presented using the right axis. Teams are ordered according to overall competitive success.

As shown in Figure 1, teams with higher penalty corner productivity generally achieved a greater number of match victories. Team 1 recorded the highest number of penalty corner goals and also achieved the greatest number of victories, whereas Team 5 recorded no penalty corner goals and no victories. Teams 2 and 3 showed relatively high penalty corner productivity, although their victory outcomes differed, suggesting that penalty corner scoring was an important but not exclusive contributor to competitive success. Overall, the visual pattern indicates a clear positive alignment between penalty corner productivity and match success, supporting the subsequent correlation and regression analyses.

Normality Assessment

Prior to inferential analysis, the Shapiro–Wilk test was conducted to assess whether the main team-level variables met the assumption of normality. As shown in Table 4, all variables produced non-significant Shapiro–Wilk results ($p > 0.05$), indicating that the distributions did not significantly deviate from normality. Therefore, Pearson's product–moment correlation coefficient was considered appropriate for examining the relationship between penalty corner goals and team victories. However, because the sample size was small, ranking consistency analysis was also applied to strengthen interpretation.

Table 4. Shapiro–Wilk Normality Test Results

Variable	Shapiro–Wilk W	p-value	Interpretation
Penalty Corner Goals	0.852	0.201	Normally distributed
Team Victories	0.987	0.967	Normally distributed
Final Ranking Position	0.987	0.967	Normally distributed

Note. Statistical significance was established at $p < 0.05$. Non-significant Shapiro–Wilk values indicate that the data did not significantly deviate from normality.

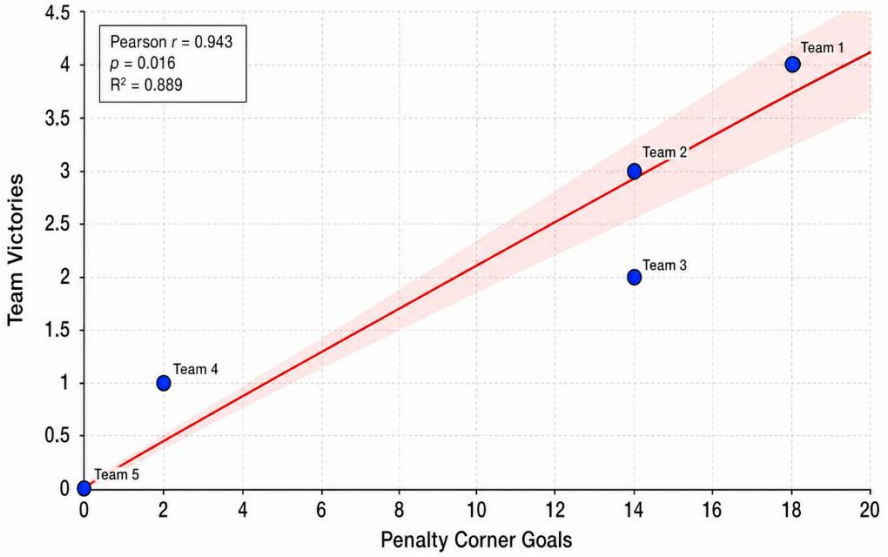
Relationship between Penalty Corner Goals and Team Victories

Pearson's product–moment correlation coefficient was used to examine the relationship between penalty corner goals and team victories. The analysis revealed a very strong positive correlation between penalty corner productivity and match success ($r = 0.943$, $p = 0.016$). This indicates that teams scoring more goals from penalty corner situations tended to record more victories during the tournament. Ranking consistency analysis was also conducted to support interpretation under small-sample conditions. The results showed a very strong association between penalty corner productivity and competitive ranking consistency ($\rho = 0.949$, $p = 0.014$), indicating that teams with higher penalty corner output were more likely to achieve stronger final tournament outcomes.

Table 5. Correlation and Ranking Consistency Analysis

Relationship Tested	Statistical Method	Coefficient	p-value	Interpretation
Penalty Corner Goals and Team Victories	Pearson correlation	$r = 0.943$	0.016	Very strong positive relationship
Penalty Corner Goals and Final Ranking Consistency	Spearman correlation	$\rho = 0.949$	0.014	Very strong ranking consistency

Pearson's product–moment correlation coefficient was used to examine the relationship between penalty corner goals and team victories. The analysis revealed a very strong positive correlation between penalty corner productivity and match success (r = 0.943, p = 0.016). To further illustrate this association, a scatter plot with a fitted regression line was constructed.



Note. The scatter plot illustrates the positive association between penalty corner goals and team victories across anonymized participating teams.

Figure 2. Scatter Plot of Penalty Corner Goals and Team Victories: The scatter plot illustrates the relationship between penalty corner goals and team victories across anonymized participating teams. The fitted regression line indicates a strong positive association, showing that teams with greater penalty corner productivity tended to achieve more match victories.

Figure 2 provides visual confirmation of the strong positive association between penalty corner productivity and team success. The distribution of data points around the fitted regression line suggests that teams generating more penalty corner goals were generally more successful in securing match victories. The positive slope of the line, together with the high coefficient values reported in the statistical analysis, indicates that penalty corner efficiency was a meaningful performance-related factor in this tournament. Although the sample size was limited, the visual trend supports the interpretation that set-piece productivity constituted an important tactical contributor to competitive success.

Predictive Contribution of Penalty Corner Productivity

Linear regression analysis was conducted to determine whether penalty corner goals predicted competitive success. The model showed that penalty corner goals significantly predicted team performance outcomes. The standardized regression coefficient was strong and positive ($\beta = 0.943$, $p = 0.016$), while the coefficient of determination indicated that penalty corner productivity explained 88.9% of the variance in team success ($R^2 = 0.889$).

Table 6. Regression Model Summary for Competitive Success

Predictor	Standardized β	R^2	p-value	Interpretation
Penalty Corner Goals	0.943	0.889	0.016	Significant positive predictor

These findings indicate that penalty corner productivity was not only associated with team victories but also contributed substantially to explaining differences in competitive outcomes among teams.

Summary of Significant Findings

Overall, the results demonstrate that penalty corner conversion productivity was strongly associated with competitive success in elite men's indoor hockey. Teams that generated more penalty corner goals tended to achieve more victories and stronger final tournament outcomes. The significant Pearson correlation, strong ranking consistency result, and high explanatory value of the regression model collectively suggest that penalty corner efficiency represents a critical tactical determinant of competitive performance in the 2025 Southeast Asian Games men's indoor hockey competition. In practical terms, these findings indicate that successful teams may gain a measurable competitive advantage through superior set-piece execution. Penalty corner conversion should therefore be regarded as a central performance indicator in elite indoor hockey analytics, coaching preparation, and match strategy development.

DISCUSSION

Interpretation of the Outcomes

The present study provides tournament-level evidence that penalty corner conversion efficiency was strongly linked to competitive success in elite men's indoor hockey at the 2025 SEA Games. The observed relationships were not merely statistically significant but also practically substantial, with penalty corner goals explaining a large proportion of variance in competitive outcomes. In an indoor format characterized by restricted space, rapid transitions, and frequent defensive congestion, the capacity to exploit structured set-piece opportunities appears to provide a decisive competitive advantage.

These findings support the interpretation that penalty corners are strategic leverage points rather than isolated match events. A successful penalty corner requires the synchronized execution of multiple specialist roles: injector, stopper, shooter, screeners, rebound players, and tactical decoys. Failure at any point in this chain can reduce scoring probability. Conversely, well-rehearsed and

tactically varied routines can create uncertainty for defenders and goalkeepers, increase the quality of shooting opportunities, and shift match momentum in favor of the attacking team.

4.2 Evaluation in Relation to Antecedent Studies

The results align with Moon et al. (2018), who emphasized the importance of structured penalty corner strategies, shot location, and tactical decision-making in international hockey. The present study extends this evidence by linking penalty corner productivity directly with tournament success in elite men's indoor hockey. While Vinson et al. (2013) focused primarily on penalty corner attack strategy in women's international outdoor competition, the current findings suggest that set-piece efficiency may be equally, and perhaps more, consequential in the indoor format.

The findings are also consistent with the broader performance analysis perspective advanced by Lord et al. (2021), who argued that hockey analysis should move toward more contextual and tactically meaningful indicators. Penalty corner goals represent such an indicator because they condense multiple layers of performance into a measurable outcome(Laird & Sutherland, 2003; Morris-Binelli et al., 2020). The relationship observed in this study further supports calls for performance analysis systems that integrate event data with tactical context, opposition behavior, and execution quality.

From the defensive and perceptual perspective, the study complements the work of (Morris-Binelli et al., 2020; Sneyimani et al., 2023). If attacking teams gain advantage through speed, disguise, and precision, defending teams must respond through anticipatory perception, goalkeeper positioning, visual attention, and rehearsed defensive coordination(Savelsbergh et al., 2002). The strong association between penalty corner productivity and success therefore highlights both sides of the tactical equation: teams must not only improve conversion but also develop evidence-based defensive countermeasures.

The findings also resonate with cross-sport evidence on special-situation efficiency. Studies in water polo, beach handball, and ice hockey have shown that structured advantage situations and shooting profiles can meaningfully shape performance outcomes (Csiernik et al., 2025; Gullikson et al., 2023; Iannaccone et al., 2020; Lupo et al., 2025). This convergence suggests that the strategic logic of converting high-value opportunities is a transferable principle across invasion and goal-oriented team sports.

4.3 Ramifications of the Discoveries

The practical implications are immediate. National teams should treat penalty corner preparation as a central component of high-performance planning rather than a supplementary training element. Training programs should allocate dedicated time to injection consistency, stopping mechanics, drag-flick power and accuracy, deception patterns, rebound positioning, and pressure simulation. Tactical variation is particularly important because predictable routines allow opponents to pre-organize defensive responses(Brocherie et al., 2024; Marris et al., 2021).

Performance analysts should also develop opponent-specific penalty corner databases. These databases should include preferred defensive running patterns, goalkeeper movement tendencies, vulnerability to drag-flick height and direction, rebound behavior, and response to deceptive variations. Video-assisted feedback can then be used to refine both attacking and defensive routines(Gómez et al., 2012; Klatt et al., 2021). In tournament contexts, rapid between-match analysis may be especially valuable because teams often face repeated opponents or tactically similar regional styles(Plakias et al., 2025).

At the policy level, the findings suggest that national hockey federations should invest in specialist coaching for penalty corners. This may include drag-flick coaching, goalkeeper anticipation training, set-piece analytics, and interdisciplinary support from biomechanics, motor learning, and sport psychology. Because indoor hockey compresses decision-making time, training should replicate competitive pressure, fatigue, and scoreboard scenarios rather than relying solely on isolated technical repetition(Brinkbäumer et al., 2024; Fernández et al., 2023).

4.4 Constraints of the Research

Several limitations must be acknowledged. First, the sample consisted of only five national teams, which restricts statistical power and limits generalizability beyond the tournament context. Second, the study used aggregated team-level data; therefore, it could not examine player-specific technical variables, shot characteristics, defensive structures, or sequence-level tactical details. Third, penalty corner opportunities and conversion rates would provide a more precise efficiency measure than goals alone, but the present analysis was constrained by the available official indicators. Fourth, the regional nature of the SEA Games means that results may not fully represent tactical dynamics in World Cup, Asian Championship, or European indoor hockey competitions.

Future studies should incorporate larger multi-tournament datasets, penalty corner attempt counts, shot location, drag-flick velocity, defensive runner behavior, goalkeeper movement, rebound sequences, and contextual variables such as match status, period, opponent strength, and fatigue. Machine learning and sequence analysis may further improve the capacity to identify tactical patterns that differentiate successful from unsuccessful penalty corners.

CONCLUSION

This study demonstrates that penalty corner conversion efficiency was a strategically influential predictor of competitive success in elite men's indoor hockey at the 2025 SEA Games. Teams that produced more penalty corner goals were more likely to win matches and achieve stronger final rankings. The evidence reinforces the concept that structured set-piece execution is not a peripheral tactical detail but a central determinant of tournament performance in the indoor hockey format.

The findings provide closure to the study's central hypothesis by showing that penalty corner productivity was strongly associated with both victory accumulation and ranking success. They also extend the discussion by linking technical execution, tactical planning, perceptual demands, and performance analytics within a single competitive framework. For coaches and national programs, the practical message is clear: systematic penalty corner development should be embedded within elite preparation, supported by video analysis, specialist training, and opponent-specific scouting.

Author-submitted suggestions for future research should include the collection of larger international datasets, the inclusion of penalty corner attempt and conversion-rate variables, and the integration of biomechanical and perceptual indicators. Authors are also encouraged to submit supplementary coding protocols or anonymized analytical datasets where permitted by tournament regulations, as such transparency would strengthen reproducibility and accelerate the development of indoor hockey performance science.

The findings of this study provide several practical applications for elite indoor hockey preparation. Coaches are encouraged to integrate dedicated penalty corner modules into regular training microcycles to ensure that set-piece execution receives systematic and measurable attention. Video analysis should be used to evaluate key technical and tactical components, including injection accuracy, stopping quality, drag-flick direction, tactical disguise, and rebound behavior. In addition, performance analysts can develop opponent-specific scouting reports to identify recurring penalty corner attack and defense patterns, allowing teams to prepare more targeted tactical responses. Penalty corner routines should also be trained under match-pressure conditions, such as fatigue, limited execution time, and score-dependent scenarios, to improve decision-making and technical consistency during competition. Finally, technical coaching should be combined with goalkeeper anticipation training and defender decision-making exercises so that both attacking and defensive penalty corner phases are developed in an integrated manner.

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CONFLICT OF INTEREST

The authors declare that they have no known financial or non-financial conflicts of interest related to this manuscript.

REFERENCES

Augste, C., & Prestel, C. (2021). *Journal of Physical Education and Sport*, *21*(4). https://doi.org/10.7752/jpes.2021.04233

Borges-Hernández, P. J., Argudo-Iturriaga, F. M., Marín, P. G., Hernández, P. B.-, & Ruíz-Lara, E. (2022). *Journal of Physical Education and Sport*, *22*(6). https://doi.org/10.7752/jpes.2022.06187

Brinkbäumer, M., Kupper, C., Reichert, L., & Zentgraf, K. (2024). Dual-task costs in speed tasks: a comparison between elite ice hockey, open-skill and closed-skill sports athletes. *Frontiers in Psychology*, *15*, 1357312. https://doi.org/10.3389/fpsyg.2024.1357312

Brocherie, F., Stetter, B. J., Poltavski, D., & Vigh-Larsen, J. F. (2024). Editorial: Hockey: testing and performance. *Frontiers in Sports and Active Living*, *6*. https://doi.org/10.3389/fspor.2024.1364470

Csiernik, B., Cavell, M., Nauboris, K., & Wattie, N. (2025). A comparison of shot selection and goal scoring between collegiate and professional women's and men's ice hockey. *Frontiers in Sports and Active Living*, *7*, 1648099. https://doi.org/10.3389/fspor.2025.1648099

Fernández, D., Cadefau, J. A., Serra-Payá, N., & Carmona, G. (2023). The distribution of different intensity demanding scenarios in elite rink hockey players using an electronic performance tracking system. *PLoS ONE*, *18*(3). https://doi.org/10.1371/journal.pone.0282788

Fernández, D., Moya, D., Cadefau, J. A., & Carmona, G. (2021). Integrating External and Internal Load for Monitoring Fitness and Fatigue Status in Standard Microcycles in Elite Rink Hockey. *Frontiers in Physiology*, *12*. https://doi.org/10.3389/fphys.2021.698463

Gómez, M. L., Subijana, C. L. D., Antonio, R. de L., & Navarro, E. (2012). Kinematic Pattern of the Drag-Flick: a Case Study. *Journal of Human Kinetics*, *35*(1), 27. https://doi.org/10.2478/v10078-012-0076-7

Gómez-Rodríguez, J., Urbaneja, J. S., Teixeira, M. C., & Cabello-Manrique, D. (2024). How Countries Compete for Success in Elite Sport: A Systematic Review. *Social Sciences*, *13*(1), 31. https://doi.org/10.3390/socsci13010031

González-Ródenas, J., López-Bondia, I., Moreno, F. C., Turpín, J. A. P., & Aranda, R. (2017). Creation of goal scoring opportunities by means of different types of offensive actions in US major league soccer. *Human Movement*, *2017*(5), 106. https://doi.org/10.5114/hm.2017.73616

Gullikson, J., Gale, L. R., Mayberry, J., Kim, J., & Killick, L. (2023). Production functions of NCAA men and women water polo matches. *Journal of Sports Analytics*, *9*(2), 141. https://doi.org/10.3233/jsa-220600

Iannaccone, A., Fusco, A., Conte, D., & Cortis, C. (2020). Notational analysis of beach handball. *Human Movement*, *23*(1), 69. https://doi.org/10.5114/hm.2021.101757

Klatt, S., Noël, B., Schwarting, A., Heckmann, L., & Fasold, F. (2021). Adaptive Gaze Behavior and Decision Making of Penalty Corner Strikers in Field Hockey. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.674511

Laird, P. W., & Sutherland, P. (2003). Penalty Corners in Field Hockey: A guide to success. *International Journal of Performance Analysis in Sport*, *3*(1), 19. https://doi.org/10.1080/24748668.2003.11868270

Lord, F., Pyne, D. B., Welvaert, M., & Mara, J. K. (2021). Field hockey from the performance analyst's perspective: A systematic review. *International Journal of Sports Science & Coaching*, *17*(1), 220. https://doi.org/10.1177/17479541211008903

Lupo, C., Volsi, D. L., Perazzetti, A., Tessitore, A., Melchiorri, G., & Ungureanu, A. N. (2025). Match analysis in elite men's senior and youth water polo, classifying actions for margins of victory and advantage. *International Journal of Sports Science & Coaching*. https://doi.org/10.1177/17479541251333923

Marris, J., Barrett, S., Abt, G., & Towlson, C. (2021). Quantifying technical actions in professional soccer using foot-mounted inertial measurement units. *Science and Medicine in Football*, *6*(2), 203. https://doi.org/10.1080/24733938.2021.1910333

Moon, J., Park, J., & Kang, K. (2018). Analysis of the penalty corner attack strategy in international women's hockey: 2016 Champions Trophy and 2016 Olympic Games in Rio de Janeiro. *Human Movement*, *19*(3), 82. https://doi.org/10.5114/hm.2018.76083

Morris-Binelli, K., Rens, F. van, Müller, S., & Rosalie, S. M. (2020). Psycho-perceptual-motor skills are deemed critical to save the penalty corner in international field hockey. *Psychology of Sport and Exercise*, *51*, 101753. https://doi.org/10.1016/j.psychsport.2020.101753

Perazzetti, A., Dopsaj, M., Mandorino, M., & Tessitore, A. (2023). Assessment of the Offensive Play in Elite Water Polo Using the Team Sport Assessment Procedure (TSAP) over an Entire Competitive Season. *Journal of Functional Morphology and Kinesiology*, *8*(3), 130. https://doi.org/10.3390/jfmk8030130

Plakias, S., Plakias, D., & Tsiakiri, A. (2025). Opponent and Real-Time Analysis in Soccer: A Game Theory-Informed Practice. *Studia Sportiva*, *19*(2). https://doi.org/10.5817/sts2025-2-9

Savelsbergh, G. J. P., Williams, A. M., Kamp, J. V. D., & Ward, P. (2002). Visual search, anticipation and expertise in soccer goalkeepers. *Journal of Sports Sciences*, *20*(3), 279. https://doi.org/10.1080/026404102317284826

Sneyimani, T., Mathenjwa, M. L., Millard, L., & Breukelman, G. J. (2023). A Review of the Essential Visual Skills Required for Field Hockey: Beyond 20-20 Optometry. *Asian Journal of Sports Medicine*, *14*(1). https://doi.org/10.5812/asjsm-126591

Stone, J., Smith, A., & Barry, A. (2021). The undervalued set piece: Analysis of soccer throw-ins during the English Premier League 2018–2019 season. *International Journal of Sports Science & Coaching*, *16*(3), 830. https://doi.org/10.1177/1747954121991447

Strafford, B. W., Smith, A., North, J. S., & Stone, J. (2019). Comparative analysis of the top six and bottom six teams' corner kick strategies in the 2015/2016 English Premier League. *International Journal of Performance Analysis in Sport*, *19*(6), 904. https://doi.org/10.1080/24748668.2019.1677379

Vasiljev, R., Hubbatullina, A. R., Povelkin, I., Yakupov, R. A., & Vasiljev, I. (2020). Biomechanical Analysis Of The Phases Of A Penalty Corner In Field Hockey. *Science And Sport Current Trends*, *8*(4), 67. https://doi.org/10.36028/2308-8826-2020-8-4-67-77

Vinson, D., Padley, S., Croad, A., Jeffreys, M., Brady, A., & James, D. (2013). Penalty corner routines in elite women's indoor field hockey: Prediction of outcomes based on tactical decisions. *Journal of Sports Sciences*, *31*(8), 887. https://doi.org/10.1080/02640414.2012.757341

West, S., Bovington, J., Dale, J., Alexander, T., Keogh, A., & Holden, S. (2025). Does the format matter? A cross-sectional analysis of suspected injuries and game events across the different versions of field hockey. *Frontiers in Sports and Active Living*, *7*, 1565036. https://doi.org/10.3389/fspor.2025.1565036

Wimshurst, Z., Sowden, P. T., & Cardinale, M. (2012). Visual Skills and Playing Positions of Olympic Field Hockey Players. *Perceptual and Motor Skills*, *114*(1), 204. https://doi.org/10.2466/05.22.24.pms.114.1.204-216