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The influence of contextual variables on individual set-pieces in elite rink hockey

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ABSTRACT

The main objective of this research was to analyse the match context variables' influence on individual set-piece's success in rink- hockey. A sample of 196 matches, including 621 free direct hits (FDH) and 292 penalties (PEN) were analysed using logistic regres- sion analysis. The results indicate that Match status has a significant effect on FDH and PEN success. Players had significantly better success in FDH when winning for by goals (OR = 2.4) and in PEN when winning by three or more goals (OR = 3.83). Conversely, players were less effective in FDH when losing by two goals (OR = 0.38). These findings suggested that contextual variables have little influence on individual set-piece success. As a general trend, it seems that set-pieces are less influenced by contextual variables than whole match, probably because are specific and individual actions between one player against the goalkeeper with- out the intervention of other players. The results of this investiga- tion could be useful to better understand the behaviour of players during specific moments like individual set-pieces and to help coaches to better tailor their strategies to improve the effectiveness in set-pieces simulating specific contextual conditions.hysical Education and Exercise and Health (CIDEFES), Lusófona University, Lisbon, Portugal

KEYWORDS

Performance analysis; roller hockey; match variables; multivariate analysis; penalty

1. Introduction

The increasing social interest and economic impact of team-sports have brought out several studies about the influence of the match variables on the final outcome (Baert & Amez, 2018; Lago-Peñas et al., 2016; Peña et al., 2013; Prieto et al., 2015). Rink hockey, also known as roller hockey or quad hockey, is not an exception and in the last years, research on match variables and other performance indicators have grown (Arboix-Alió & Aguilera-Castells, 2018; Arboix-Alió et al., 2020; Gómez et al., 2011).

Among the different rink hockey game variables that can influence the match result, individual set-pieces, such as penalties (PEN) or free direct hits (FDH), are probably the most relevant. These set-pieces are particular events involving a direct opposition between the shooter and the goalkeeper. In PEN, the shooter has five seconds to start the execution, consisting of a direct shot on goal from the penalty point (5.4 metres). In FDH, the taker has five seconds to start the execution (from 7.4 metres), being able to choose a direct shot or approaching and dribbling the goalkeeper to score.

Formerly, the PEN and the FDH were actions that happened a few times during a match. However, in the 2009–10 season, a new rink hockey regulation aiming to achieve a more offensive style came into effect. The main objective of this new regulation was to more strictly penalise the fouls committed and consequently increase the number of goals. In this vein, the 45-sec. ball possession limit, the accumulation of 10 team fouls and the subsequent penalisation with a FDH, or the temporary numerical inferiority when a player is sanctioned with a blue card, generated more goals opportunities (5,93 goals per match before and 7,13 goals per match after) (Arboix-Alió & Aguilera-Castells, 2019). Furthermore, Arboix-Alió, Aguilera-Castells et al. (2019) found significant differences between team ranking and set-piece effectiveness. The best teams of the Spanish League (Ok Liga) showed a higher percentage of success. Moreover, these actions become more decisive because in the final minutes there is an increase in the amount of

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FDH (Trabal et al., 2020) and frequently contributes to tip the balance in favour of one of the two contenders in the critical match moments (Navarro et al., 2009).

Previous rink hockey studies have shown the multifactorial nature of performance, composed of different technical, tactical, psychological, and conditional variables (Trabal, 2019; Vaz, 2011). However, few studies have analysed the influence of the contextual variables on the match outcome (Arboix-Alió & Aguilera-Castells, 2018; Arboix-Alió et al., 2020; Gómez et al., 2011) or the set-piece success (Trabal, 2019). Among these studies, match location has been analysed in the Spanish league showing that local teams obtain a higher percentage of points (around 60%) when they play at home (Arboix-Alió & Aguilera-Castells, 2019; Arboix-Alió et al., 2020; Gómez et al., 2011). Other studies have shown that scoring first is a variable associated with wins (Arboix-Alió & Aguilera-Castells, 2018) like finishing the first half leading the match (Arboix-Alió, Aguilera-Castells et al., 2019). Regarding individual set-piece actions, Trabal et al. (2020) showed no significant influence of the contextual variables on the FDH effectiveness in the Spanish League. However, the level bias between Spanish clubs, mainly due to the different budgets of teams with professional and semi-professional athletes competing in the same league (Arboix-Alió, Buscà et al., 2019), was not taken into account.

The effect of the individual set-pieces on team-sports match outcome is a common topic of study in sports science. However, to the best of our knowledge, no research has been found to analyse the influence of the contextual variables on individual set-pieces in rink hockey. Therefore, the aim of this investigation was to analyse the influence of the contextual match variables on the FDH and PEN success in matches played between high-standard teams.

2. Methods

A total of 621 FDH and 292 PEN shot in 196 matches throughout ten seasons (2009–2010 to 2018–2019) were analysed. All games corresponded to the following competitions: World Cup (n = 32); European Cup (n = 39); WS Europe Cup (CERS Cup) (n = 90); Champions League (n = 74); Continental Cup (n = 42); Intercontinental Cup (n = 28); Spanish Copa del Rey (n = 84); Portugal Cup (n = 77); Italian Cup (n = 30); Supercopa de España (n = 68); Supercoppa Italiana (n = 16); Supertaça de Portugal (n = 41). To avoid the difference level bias, only the matches played between high-standard teams were included (finals, semi-finals, and matches between the top three ranked teams in the regular leagues).

2.1. Data coding system

Data were analysed using a punctual and nomothetic design. An ad hoc observational tool was created consisting of a field format combined with a category system. The observational tool was designed including context and the set-piece's effectiveness variables (Table 1).
To assess data reliability, 100 individual set-pieces were selected and two different observations (two weeks between observations) were performed by one expert observer to assess intra-rater reliability. Moreover, the same set-pieces were observed by another expert to assess the inter-rater reliability. Kappa values were k = 0.992 for intra-observer and k = 0.984 for inter-observer reliability. In addition, a generalisability analysis was carried out (Cronbach et al., 1972), using the SAGT software, version 1.0 (Hernández- Mendo et al., 2016) (Table 2). Following the suggestions from Blanco-Villaseñor et al. (2014), two measurements were made to assess: a) the results generalisability; and b) the validity of the observation instrument. The generalisability coefficient (relative and absolute = 0.996) corresponding to the measurement plan [Categories]/[set-pieces] establishes that the number of set-pieces analysed yields high reliability of the general- isation precision. Regarding the measurement plan [set-pieces]/[Categories], the gener- alisability coefficient (relative and absolute = 0.000), guarantees – in the theoretical

framework of the Theory of Generalisability – the validity of the observation instrument designed (Blanco-Villaseñor et al., 2014; Blanco-Villaseñor & Escolano-Pérez, 2017).

Table 1. Criteria and categories of the observation instrument.

Criteria	Categories
Round	Round: final/semi-final/regular season.
Match location	Match location of team who shoots the FDH or PEN: Home/Visitor/Neutral.
Match time	Moment of the match when the FDH or PEN is shot: T1 (0–12:30)/T2 (12:31–25:00)/T3 (25:01–37:30)/T4 (37:31–50:00)/T5 (extra time).
Match status	Match result in the moment when the FDH or PEN is shot: D (draw)/W1 (win for one goal)/W2 (win for two goals)/W3 (win for more than two goals)/L1 (loss for one goal)/L2 (loss for two goals)/L3 (loss for more than two goals).
Set-piece's importance (Match critical moment)	Match critical moment: PEN or FDH in the last five minutes of the match or in the extra time with a match result of WO, W1 or L1./No match critical moment.
Result of the action	FDH or PEN success: Goal/No goal.

Table 2. Results corresponding to the generalisability design [Categories] [Set-pieces].

	SC	*df*	Mean square	Random	Mixt	Corrected	%	Standard error
[set-pieces]	0.33	636	0.001	−0.005	−0.005	−0.005	0	0
[cat]	1014.638	26	39.025	0.061	0.061	0.061	30.645	0.016
[set-pieces][cat]	2284.621	16,536	0.138	0.138	0.138	0.138	69.355	0.002

2.2. Statistical analysis

Descriptive statistics were performed to calculate the effectiveness percentages of each variable (percentage of effectiveness in the FDH (% EFDH) = (FDH goals * 100/FDH thrown) and percentage of effectiveness in the PEN (% EPEN) = (PEN goals * 100/PEN thrown). A Chi-square test was performed to determine whether each independent variable (Round; Match location; Match time; Match status; Set-piece importance) was associated with the individual set-pieces outcome (i.e. goal or no goal). A logistic regression analysis was performed to examine the relationship between the set-piece effective- ness, and independent variables. Odds ratio and 95% confidence intervals were calculated from the beta coefficients and standard errors. The odds ratio showed the change in odds, meaning that if the value was greater than 1, the odds of the outcome increased. Conversely, if the value was lower than 1, the odds decreased. The hypothesis that the logistic model adequately fit the data was tested by means of the goodness of the fit χ^2 test (Hosmer & Lemesbow, 1980). Statistical analysis was conducted using SPSS (Version 22 for Windows; SPSS Inc., Chicago, IL, USA).

3. Results

The individual set-piece effectiveness was 27.8% for FDH and 43.5% for PEN. Only the Match status had a significant effect on both FDH and PEN effectiveness (Tables 3 and 4).

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Table 3. Descriptive statistics and percentages of FDH and results of regression logistic.

Variables FDH	FDH shot	%FDH shot	Goals of FDH	% goals of FDH	% EFDH	Odds ratio	CI (95%) Odds ratio	p
Round								
Final	282	45.4	83	48	29.4	1.00 (ref)		
Semi-Final	313	50.4	84	48.6	26.8	.930	.638–1.355	.705
Regular Season	26	342	6	3.4	23.1	.689	.257–1.846	.459
Match location								
Visitor	114	18.4	41	23.7	36	1.00 (ref)		
Home	144	23.2	46	26.6	31.9	.764	.445–1.311	.329
Neutral	363	58.5	86	49.3	23.7	**.510**	**.318-.820**	**.005****
Match time								
T4	294	43.3	83	48	28.2	1.00 (ref)		
T1	33	5.3	13	7.5	39.4	1.973	.863–4.515	.107
T2	99	15.9	27	15.6	27.3	.946	.533–1.677	.849
T3	171	27.5	40	23.1	23.4	.821	.506–1.331	.423
T5	24	3.9	10	5.8	41.7	1.779	.656–4.828	.258
Match status								
D	155	25	44	25.4	28.4	1.00 (ref)		
W1	89	14.3	28	16.2	31.5	1.379	.750–2.536	.301
W2	78	12.6	33	19.1	42.3	**2.401**	**1.270–4.542**	**.007****
W3	53	8.5	15	8.7	28.3	1.196	.556–2.571	.647
L1	113	18.2	32	18.5	28.3	1.191	.669–2.119	.552
L2	68	11	7	4	10.3	**.375**	**.153-.923**	**.033***
L3	65	10.5	14	8.1	21.5	.787	.372–1.655	.532
Set-piece's importance								
Critical moment	81	13	27	15.6	33.3	1.00(ref)		
No critical moment	540	87	146	84.4	27	.935	.473–1.849	0.848

Match time: T1 – 1–12:30 minutes; T2 – 12:31–25:00 minutes; T3 – 25:01–37:30 minutes; T4 – 37:31–50:00; T5 – Extra time. Match status: D (Draw); Win for one goal (W1); Win for two goal (W2); Win for more than two goals (W3); Loss for one goal (L1); Loss for two goals (L2); Loss for more than two goals (L3).

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Table 4. Descriptive statistics and percentages of PEN and results of regression logistic.

Variables PEN	PEN shot	%PEN shot	Goals of PEN	% goals of PEN	% EPEN	Odds ratio	CI (95%) Odds ratio	p
Round								
Final	122	41.8	53	41.7	43.4	1.00 (ref)		
Semi-Final	162	55.5	70	55.1	43.2	1.043	.630–1.725	.871
Regular Season	8	2.7	4	3.1	50	1.702	.373–7.859	.492
Match location								
Visitor	38	13	17	13.4	44.7	1.00 (ref)		
Home	73	25	32	25.2	43.8	.926	.405–2.120	.856
Neutral	181	62	78	61.4	43.1	.910	.440–1.885	.800
Match time								
T4	101	34.5	39	30.7	38.6	1.00 (ref)		
T1	50	17.1	25	19.7	50	1.637	.711–3.770	.247
T2	77	26.4	34	26.8	44.2	1.212	.591–2.487	.600
T3	57	19.5	28	22	49.1	1.393	.651–2.981	.393
T5	7	2.4	1	0.8	14.3	.513	.047–5.593	.584
Match status								
D	95	32.5	37	29.1	38.9	1.00 (ref)		
W1	23	7.9	13	10.2	56.5	2.002	.774–5.777	.152
W2	24	8.2	10	7.9	41.7	1.208	.462–3.560	.699
W3	16	5.5	11	8.7	68.8	3.833	**1.138–12.915**	**.030****
L1	59	20.2	27	21.3	45.8	1.379	.688–2.763	.365
L2	45	15.4	20	15.7	44.4	1.405	.632–3.231	.404
L3	30	10.3	9	7.1	30	.801	.290–2.210	.669
Set-piece's importance								
Critical moment	18	6.2	4	3.1	22.2	1.00 (ref)		
No critical moment	274	93.8	123	96.9	44.9	1.921	.458–8.061	.373

Match time: T1 – 1–12:30 minutes; T2 – 12:31–25:00 minutes; T3 – 25:01–37:30 minutes; T4 – 37:31–50:00; T5 Extra time. Match status: D (Draw); Win for one goal (W1); Win for two goal (W2); Win for more than two goals (W3); Loss for one goal (L1); Loss for two goals (L2); Loss for more than two goals (L3).

3.1. Round

Regarding the kind of match (final, semi-final, or regular season) neither FDH (odds ratio [OR] = 0.93; 95% CI: .638–1.355; p = 0.705 for semi-final; OR = 0.689; 95% CI: .257–1.846; p = 0.459 for regular season) nor PEN (OR = 1.043; 95% CI: .630–1.725; p = 0.871 for semi-final; OR = 1.702; 95% CI: .373–7.858; p = 0.492 for regular season) has been influenced by this specific situation (Table 3).

3.2. Match location

The probability of scoring a FDH as a visitor was higher than as a local or neutral (36%, 31.9%, and 23.7%, respectively). The probability of scoring as a neutral was significantly lower than as a visitor (OR = 0.51; 95% CI: .318–.820; p = 0.005) (Table 3). Moreover, visitors achieved higher but not significant PEN effectiveness (44.7%) compared to locals (43.8%) and neutrals (43.1%) (Table 4).

3.3. Match status

The Match status had a significant effect on both the effectiveness of the FDH and the PEN. Players were more successful with a favourable score compared to when they were losing or drawing. The probability to score a PEN with a W3 result was 3.833 times higher than D result (95% CI: 1.138–12.915; p = 0.03). Moreover, in the FDH the odds of scoring with a W2 result was 2.401 times higher than D result (95% CI: 1.270–4.542; p = 0.007). Otherwise, the odds of scoring a FDH with a L2 result were 0.375 lower than D result (95% CI:,153–0.923; p = 0.033).

In both FDH and PEN, teams shot more individual set-pieces with an unfavourable outcome (39.6% FDH and 45.9 % PEN) than a favourable outcome.

3.4. Match time

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The 74.9% of the FDH were executed in the second half (T3 = 27.5% and T4 = 43.3%), following a similar trend in PEN (54.1% in the second half vs. 43.5% in the first). Regarding effectiveness, it was lower in the second half both in PEN (30.3% vs. 26.4%) and in FDH (46.4% vs. 42.4%). Despite not finding significant differences, during extra time and T1, players achieved the highest FDH effectiveness (41.7% and39.4%, respectively). On the other hand, the highest PEN effectiveness was during T4 (49.1%).

3.5. Set-piece importance

Regarding the critical moment of the match (PEN or FDH in the last five minutes of the match or in the extra time with a match result of WO, W1 or L1), neither FDH nor PEN have been influenced by this specific situation. Despite not being significant, the higher FDH effectiveness was during critical moments (33.3%) but in PEN was during non- critical moments (44.9%).

4. Discussion

The main purpose of this investigation was to analyse the influence of the contextual match variables on the individual set-piece success (FDH and PEN) in rink hockey.

The main findings were that Match status was the only variable that influenced both FDH and PEN effectiveness. Thus, the present results show little influence of the contextual variables on the success of these kinds of actions.

Similarly to Trabal et al. (2020) analysing the Spanish League (29.7% of effectiveness for FDH), the present study found an individual set-piece effectiveness of 27.8% for FDH and 43.5% for PEN. Although no previous studies have analysed the PEN effectiveness in rink hockey, the present results show that players are more successful in PEN than in FDH. This difference could be explained because the PEN is an action that has to be executed as a direct shot (from 5.4 metres) and the goalkeeper cannot move until the player hits the ball. In contrast, in the FDH, the player can advance towards the goal enabling the goalkeeper a higher variability of options to anticipate. It can be speculated that goalkeepers are abler to influence the action of the FDH taker when he/she decide to approach the goal before the shot, thus taking up space and minimising the chances to score. Moreover, when the taker shoots the FDH directly, the goalkeeper joins some additional milliseconds to stop the ball. Therefore, scouting the set-piece specialists of the opponent team, seems an essential task to succeed (Sousa et al., 2021), especially in PEN, where because of the short distance, the goalkeeper does not have enough time to react and has to anticipate the ball direction (Trabal, 2019).

4.1. Match location

The probability of scoring a FDH as a neutral was significantly lower than as a visitor (OR = 0.510). Additionally, despite not being significant, visitors were more successful than locals. These findings could be due to the higher motivation of playing against the local crowd. Furthermore, the fear of failure in front of the local crowd could be present in FDH having a negative influence (Arrondel et al., 2019). This phenomenon was also reported in basketball by Jiménez-Torres and López Gutiérrez (2012), where visitors achieved a better performance in free throws than locals during extra-time. In the same vein, in rink hockey where the percentage of success in FDH is less than 30%, it seems logical to assume that in matches played between high-standard teams, local goalkeepers have higher pressure than visitor shooters. This could be the reason why Match location had only a significant effect on FDH but not in PEN. As we mentioned before, PEN is a direct shot where players (shooters and goalkeepers) face less complexity than FDH, and players likely have less fear of failure in front of their supporters.

Surprisingly, individual set-pieces do not benefit from Home Advantage effect reported to be around 60% in rink hockey (Arboix-Alió & Aguilera-Castells, 2019; Arboix-Alió et al., 2020). Although no previous research in rink hockey has analysed the influence of match location in individual set-piece effectiveness, the present results agree with other similar team sports. In ice-hockey no significant differences were found between match location and success in shootouts (Loignon, et al., 2007), and in handball, some studies have reported that visitors were more

effective than locals in 7-metres shoots (Casimiro, 2010; Hantau & Hantau, 2014). According to Casimiro (2010), this lack of Home Advantage effect could be explained by the fact that individual set-pieces are specific events between the taker against the goalkeeper and are less influenced by the variables that explain Home Advantage such as away-team travels, familiarity with local facilities, local crowd support, referee bias, territoriality or tactics issues (Carron et al., 2005; Courneya & Carron, 1992; Nevill & Holder, 1999; Pollard, 2006).

4.2. Match status

Players were more successful when they were winning the match. The best match status for FDH was W2 (OR = 2.401) and for PEN W3 (OR = 3.833). Conversely, in FDH players had less than half of the possibilities to score a goal when L2 (OR = 0.375). In a similar study, Trabal et al. (2020) reported the best FDH effectiveness was with a favourable score (W2 and W3). The association between the increase of effectiveness with a positive score and the decrease in effectiveness with a losing score can be explained by the athlete's confidence. Shooting a FDH or PEN winning by two or more goals, allows the player to face this challenge with confidence. In such situations, the goalkeeper could be influenced by the loss of concentration or motivation when there is no chance to win the match. In accordance to the cognitive activation theory of stress, changes in andro- gens levels driven by competition would modify the behaviour of athletes in subsequent interactions depending on the outcome of the moment (Oliveira et al., 2009). This difference in hormonal response to competition between winners and losers has been documented in different contests that involve physical confrontation (Fry et al., 2011) and could also explain the difference in set-piece performance between winners and losers observed in the present study.

In the same vein, Sousa et al. (2020) reported that when a team had at least two or more goals than the opponent, the effectiveness of the opponent goalkeepers was reduced by 45% versus a tied match status in the Portuguese Rink Hockey First Division. These findings agreed with Ahart (1973) and Jiménez-Torres and López Gutiérrez (2012) demonstrating the association between the effectiveness of the set-pieces and the low- medium pressure status.

Regarding the total number of set-pieces, teams executed more FDH and PEN with an unfavourable score, especially in the PEN where doubling of these actions were shot when the team was losing the match. Probably because the losing teams need to generate more direct actions inside the area, which increases the possibility of defenders committing fouls or penalties.

4.3. Match time

During the second half, there was an increase in FDH (25.1% vs. 74.9%) and PEN (45.9% vs. 54.1%) compared to the first half. The increase in shots during the second half in rink hockey matches, not only happens in individual set-pieces (Trabal et al., 2020) but also in all kinds of shots (Sousa et al., 2020), similar to other team sports such as soccer (Maneiro Dios, 2014) or basketball (Jiménez-Torres & López Gutiérrez, 2012; Kozar et al., 1994). The main reason for the differences in the number of individual set-pieces between match halves is likely due to the increase of FDH caused by the accumulation of team fouls. In rink hockey, when a team commits the first cycle of fouls (10 fouls), it is sanctioned with one FDH against. Subsequently, every five fouls committed is sanctioned with another FDH. Therefore, as the match progresses, more fouls are committed, thus increasing the probability of being penalised with an FDH. On the other hand, PEN are not related to foul cycles and this would explain the parity between both halves. Moreover, tactical and strategic team decisions could explain this increase in the second half since in the last minutes losing teams are forced to play more aggressively to regain ball possession, committing more defensive fouls. Additionally, due to the accumulated physical and mental fatigue throughout the match, defenders probably tend to commit more fouls for tackling late.

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In contrast with Sousa et al. (2020) and Trabal et al. (2020) reporting effectiveness increases during the second half (27.3% vs. 30.2%), the present study reported less effectiveness of PEN and FDH in the second half (30.3% vs. 26.4 % and 46.4% vs. 42.4% in FDH and PEN, respectively). While Trabal et al. (2020) analysed the regular- season in the Spanish League, with low competitive balance (Arboix-Alió, Buscà et al., 2019), this study only considered matches between high-standard teams. In imbalanced matches, many FDH and PEN are shot under W2 or W3 and this fact subtracts significance to the set-pieces, thus increasing effectiveness due to the psychophysiological reasons mentioned previously.

4.4. Set-piece importance

No significant differences were found in FDH or PEN effectiveness during critical match moments and few PEN (6.2%) were shot during this period. Conversely, the highest amount of FDH (43%) was during the last part of the match (T4). This fact could be explained again due to the rules of rink hockey, where the accumulations of 10 defensive fouls end up generating a FDH. In the same vein, many teams wait for the final minutes to play a more direct and risky style, either to pressure the opposing team to regain the disadvantage on the scoreboard or to maintain a favourable result. This increase in intensity creates situations that make it easier to commit fouls or receive blue cards, which are sanctioned with a FDH.

The present investigation also has some limitations that should be acknowledged and addressed in future studies. Firstly, the lack of studies about rink hockey to establish comparisons reduces the possibility to identify some tendencies between findings. In addition, the technical actions of players have not been analysed. The strengths of our study lie in the novelty, being the first study to analyse these match variables in rink hockey. Moreover, in the number of set-piece actions analysed during a ten-year period from the most prestigious rink hockey competitions, which is a comprehensive study on a minority sport over time. A future line of research would be the study of the combination of different context factors such as match location with match status. On the other hand, further research should replicate our findings in other rink hockey competitive contexts like the female hockey league or lower levels of competition (grassroots sport or minor leagues).

4.5. Conclusions and practical applications

In conclusion, the current study indicates that contextual variables have little influence on individual set-piece success in rink hockey matches. Only Match status variable had a significant effect on both actions (FDH and PEN). As a general trend, it seems that set- pieces are less influenced by contextual variables than whole match, probably because are specific and individual actions between one player against the goalkeeper without the intervention of other players.

This research provides a better understanding of the rink hockey players' performance in FDH and PEN during the most important matches. The results of this investigation could be useful for coaches and researchers to understand the behaviour of rink hockey players under specific match circumstances. In light of these results, new training strategies can be implemented to improve the effectiveness of FDH and PEN simulating specific scenarios. It could especially prove useful in preparing players with specific psychological exercises focusing on the game and not being influenced by the Match status variable.

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No potential conflict of interest was reported by the authors.

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