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The Difference Between Winners and Losers in Balanced Handball Games in the Final 10 Minutes

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Abstract

The objectives of this study are to analyze handball game-related statistics in balanced games (0-2 goal difference at minute 50) in the final 10 minutes regarding the final outcome of winning or losing. i) Analyse statistical differences between winners and losers in male and female top Icelandic handball leagues and ii) calculate a discriminating model for performance variables for both male and female top Icelandic handball leagues. The game-related statistics from the final 10 minutes of 127 games from two seasons (85 male and 42 female) with a goal difference of two or fewer at minute 50 were analyzed. The internal consistency and reliability ranged from good to excellent for the games of both sexes. Differences between winning or losing for each sex were determined using the unpaired t-test or Mann-Whitney U test, and Cohens d for effect sizes was calculated. The results for males include four variables with large effect sizes and six with significant differences. The discriminatory model selected technical fouls and goalkeeper blocked shots from 9 m to classify 40.4% correctly (Wilks' lambda 0.005, and canonical correlation of 0.997). For females, findings align with previous research underscoring the importance of 9 m shots at goal at this level. However, they differ somewhat from full game statistics at the elite level with no difference in red cards and 7 m shots. Coaches should pay particular attention in tactical preparation to shots outside 9 m – both offensively and defensively in balanced games in the final 10 minutes.

Keywords: *Performance, notational analysis, discriminatory analysis, league, amateur*

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Introduction

In recent years, the literature on performance analysis in handball has grown with emerging technologies and more detailed game-related statistics. However, gameplay can only be partially described by the static outcome statistics (what) as the processes behind each play (how) are dynamic. Most performance analyses rely on standard performance indicators such as number of attacks, offensive efficiency, shots, shots efficiency, goalkeepers' efficiency, the average number of suspensions, and statistics according to playing positions and

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event locations on the court (Ferrari et al., 2019).

Several papers on the differences between winners and losers have recently been published. One recent article identified discriminatory variables for winners in the female's World Championships from 2007 to 2017, grouping games into clusters by the final outcome. Defensive variables (stolen balls, blocked throws, and goalkeeper's efficiency indicators) contributed more to balanced games than attack variables. Also, a higher number of technical faults were associated with lower chances of winning (de Paula et al., 2020). Another paper on male play from four past Olympic Games indicated winners perform better in total shot efficiency and from 9 m, assists, and goalkeeper blocked shots in fast breaks than losing teams. Additionally, a model correctly classified 82% of the games using only four variables of shots, goalkeeper-blocked shots, technical fouls, and the number of attacks (Saavedra et al., 2017a). With similar methods, discriminatory models have been constructed for the domestic league level in Iceland for male and female play, providing insight into a topic with minimal previous research. Using five variables (shots, goalkeeper blocked saves [GB saves], steals, technical fouls, GB 7 m saves), 84% of games were correctly classified between winners and losers. Though only shots and GB saves were enough to classify 87% correctly for females (Þorgeirsson et al., 2022).

Only a few studies have examined balanced games (de Paula et al., 2020; Pic, 2018) or concentrated on the final minutes (Debanne et al., 2018; Lozano et al., 2016) or both (Prieto et al., 2015) in handball. A more extensive literature on these critical last minutes of playing time exists in other sports such as basketball (Gómez et al., 2018). The handball coach plays an active role in the game by managing the on-field players and tactics at any moment. The coach can directly impact the game with time-outs (Gutiérrez-Aguilar et al., 2016), player´s on-court time (Büchel et al., 2019) and moderate defensive tactics, thinking about the effects of fouls (Fasold & Redlich, 2018; Laxdal & Ivarsson, 2022), and exclusions (Prieto et al., 2015). Therefore, coaches need to know if the final minutes in balanced matches represent a different situation from the rest of the game to make better decisions in the match. Furthermore, a previous review study has suggested comparing winning teams to losing teams during an entire season to understand the most crucial performance indicators during specific game periods (Ferrari et al., 2019). In line with that, the primary purpose of this research is to analyze handball game-related statistics in balanced games (0-2 goal difference at minute 50) in the final 10 minutes regarding the final outcome of winning or losing. i) Analyse statistical differences between winners and losers in male and female top Icelandic handball leagues and ii) calculate a discriminating model for performance variables for both male and female top Icelandic handball leagues.

Methods

Participants

A total of 127 handball games (85 male and 42 female) from the top Icelandic league spanning two seasons (2018-2019 and 2019-2020) were analyzed with game-related statistics. The data set included only games in goal-scoring balance at minute 50 with a goal difference of two or fewer. Matches resulting in a draw (n= 26 male and 8 female) were also excluded as the statistics from the last 10 minutes were analyzed by the final game outcome of winning or losing. In the top Icelandic league, 12 teams compete in the top male leagues (out of three), and females have eight teams in the top league (out of two). The majority of senior teams (male and female) have players 18 years and older, however, coaches do include youth aged players in their teams. The full dataset is available online at https://hbstatz.is/ (a collaboration between the Icelandic Handball Federation and HBStatz company).

Procedures

During handball games, trained observers entered the game-related statistics on a computer using a specifically designed application named HBStatz written in VB.net PHP and SQL code. The data was then extracted from the database for further processing in Excel and subject to error checks by one of the authors [SÞ] to detect possible errors before importing it into the statistical analysis software. Authors extracted the information used in the study from sources available in the public domain on a website (male league: [https://hbstatz.is/OlisDeildKarlaLeikir2018.php, https://hbstatz.is/OlisDeildKarlaLeikir2019.php] and female league: [https://hbstatz.is/OlisDeildKvennaLeikir2018.php, https://hbstatz.is/OlisDeildKvennaLeikir2019.php] and therefore no participant informed consent was needed. This method of obtaining data has been commonly used in performance analysis in team sports, such as handball (Calin, 2010; Meletakos et al., 2011; Yamada et al., 2011; Pollard & Gomez, 2012). In this study, game outcome of winning or losing is the dependent variable, and the independent variables are listed in table 1.

Table 1. Definitions of the game-related statistics.

Variable	Definition
Shots	Percentage of converted shots relative to the number of shots made.
6 m shots	Percentage of converted shots at 6 m relative to the number of shots made. The shot is from a zone outside the 45° angle from the left and the right.
7 m shots	Percentage of penalties (7 m) converted relative to the number of penalties taken.
9 m shots	Percentage of converted shots at 9 m relative to the number of shots made. The shot is from a backcourt player either (a) over or through the defence, or (b) after a breakthrough but with a defensive player in front.
Wing shots	Percentage of converted shots from the wing area relative to the number of shots made. The shot is from a zone within the 45° angle from the left and the right without a defence player in front.
Fast-break shots	Percentage of shots converted in a fast-break situation (rapid switch from defense to attack without the defense organized) relative to the number of shots made in this situation.
Breakthrough shots	Percentage of shots converted in a breakthrough situation relative to the number of shots made in this situation (a) from a backcourt player after breakthrough in the 9 m zone without a defence player in front, (b) from the pivot after a 1:1 situation, (c) from the left or right back after a breakthrough of a 1:1 situation.

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Variable	Definition
Yellow cards	Yellow cards received by each player and/or coaching staff member.
Red cards	Red cards received by each player and/or coaching staff member.
2-min exclusions	2-minute suspension received by each player and/or coaching staff member.
Assists	Number of passes from one offensive player to another leading directly to a goal scored.
Technical fouls	Number of turnovers made by the offensive team where the ball is awarded to the defence due to a foul in the offence.
Steals	Number of turnovers in favor of the defence due to actions of anticipation and snatching the ball.
GB saves	Percentage of shots stopped relative to the number of shots made by the attackers.
GB 6 m saves	Percentage of 6 m shots stopped relative to the number of shots made by the attackers.
GB 7 m saves	Percentage of penalties (7 m) stopped relative to the number of penalties taken by the attackers.
GB 9 m saves	Percentage of 9 m shots stopped relative to the number of shots made by the attackers.
GB wing saves	Percentage of shots stopped in the wing area relative to the number of shots made by the attackers.
GB fast-break saves	Percentage of shots stopped in fast-break situations relative to the number of shots made by the attackers.
GB breakthrough saves	Percentage of shots stopped in breakthrough situations relative to the number of shots made by the attackers.

The data was validated with the use of an ad hoc observational instrument (Anguera, 2003; Anguera, Camerino, Castañer, Sánchez-Algarra & Onwuegbuzie, 2017) and LINCE software package (Gabín, Camerino, Anguera & Castañer, 2012). Four subgroups were created for the organization of the variables; (i) shots (shots, 6 m shots, 7 m shots, 9 m shots, wing shots, fast-break shots, breakthrough shots); (ii) fouls (yellow card, red card, 2-minutes exclusions); (iii) goalkeeper-blocked (goalkeeper-blocked 6 m shots, 7 m shots, 9 m shots, wing shots, fast-break shots, and breakthrough shots) and (iv) other variables (assists, technical fouls, blocks, steals).

Table 2. Intra- and inter-observer internal consistency (Cronbach's alpha – α) and reliability (intra-class correlation coefficient – ICC, and Cohen's kappa – κ).

	Men						Female					
	Intra-observer			Inter-observer			Intra-observer			Inter-observer		
Variable Group	α	ICC	κ	α	ICC	κ	α	ICC	κ	α	ICC	κ
Shots	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Cards and exclusions	1.000	1.000	1.000	0.876	0.866	0.816	1.000	1.000	1.000	0.657	0.657	0.621
Goalkeeper-blocked	0.976	0.976	0.961	0.837	0.837	0.832	0.816	0.816	0.8	0.816	0.816	0.8
Other variables	0.882	0.882	0.784	0.69	0.69	0.731	0.976	0.976	0.965	0.781	0.781	0.619
Mean	0.965	0.965	0.928	0.851	0.848	0.845	0.948	0.948	0.988	0.814	0.814	0.747

Statistical analysis

Descriptive statistics (mean and standard deviation) were calculated for game-related statistics by game outcome (winning and losing teams) and by sex. The reliability of data was determined using Cohen's kappa (κ) values and Cronbach's alpha (α) for internal consistency and intra-class correlation coefficients (ICC). Four games were chosen by random, analyzed (two females and two males), and calculated for intra-observer internal consistency and reliability (at two different times) and inter-observer internal consistency and reliability (to compare the observation record with the one obtained from the official website). The cut-off points between 0 and 1 (Peterson, & Kim, 2013), were: for α (internal consistency) <0.50 unacceptable, 0.51-0.60 poor, 0-61-0.70 questionable, 0.71-0.80 acceptable, 0.81-0.90 good, and ≥0.91 excellent (George, & Mallery, 2003); for ICC (reliability) ≤0.50 poor, 0.51-0.75 moderate, 0.76-0.90 good, and ≥0.91 excellent (Koo & Li, 2016); and for κ (reliability) <0.01 no agreement, 0.01–0.20 poor, 0.21–0.40 discrete/regular, 0.41–0.60 moderate, 0.61–0.80 good, and 0.81–1.00 very good (Landis & Koch, 1977). Table 2 lists the internal consistency and reliability results of the intra-observer and inter-observer mean. For males, the intra-observer results are very good (κ) and excellent (α and ICC), and the inter-observer values are good (α and ICC) and very good (κ). For females, intra-observer results are very good (κ) and excellent (α and ICC), and inter-observer results are good (α, ICC, and κ).

Kolmogorov-Smirnov test was used to determine the normality of each variable. Differences between winning and losing teams in the male and female top league were calculated with a parametric (unpaired t-test) or non-parametric (Mann-Whitney U) test, according to whether the variable was normally distributed or not. The effect sizes (ES) interval of >0.2 small, >0.5 moderate and >0.8 large were used to interpret the differences calculated according to recommendations (Cohen, 1988). The authors performed a discriminant analysis with a sample-splitting method depending on the game outcome (winning and losing teams) for both males and females. Wilks' lambda (λ) measures the deviations within each group relative to the total deviations. That criterion was used to determine whether or not a variable is discriminatory. The sample-splitting method initially included the variable that best minimized the value of λ under the provision that the value of F was greater than a specific critical value (F = 3.84, "include"). From that point on, the method combined the variables pairwise. The new variable was selected if λ was greater than the value of the input F. Before introducing a variable, an

attempt to eliminate those that had already been selected was made, as long as the increase in the minimized λ was below a critical threshold (F = 2.71, "remove"). The canonical correlation index (λ) was calculated (deviations of the between-group discriminant scores relative to the total deviations), and the percentage of correctly classified games (winning and losing teams). A p-value <0.05 was considered to be statistically significant. The statistical analysis was performed with the software package SPSS version 27.0 (Version 27.0; IBM, Armonk, NY, USA).

Results

Table 3 compares means of game-related statistics for males during the last 10 minutes of balanced games by game outcome (winning and losing) with standard deviations using a non-parametric test (Mann-Whitney) with p values and effect sizes. Ten variables in total showed significant differences (alpha level <0.05) depending on the game outcome. Four variables had large effect sizes using Cohen's d > 0.80. In order of decreasing effect sizes these variables were: shots (d = 1.114) , GB 9 m saves (d = 1.100), 9 m shots (d = 0.875) and GB saves (d = 0.827).

Table 3. Basic descriptors (mean and standard deviation), Mann-Whitney U test (non-parametric test), p-value, and the effect size of the differences (Cohen's d) for each variable according to the game outcome in males.

Variable	Winners	Losers	U	*p*	ES
Shots (%) [a]	68.20 ± 17.01	49.12 ± 17.22	1565.00	<0.001	1.114
6 m shots (%) [a]	77.16 ± 36.81	73.91 ± 40.62	1220.00	0.855	0.084
7 m shots (%) [a]	72.36 ± 41.77	80.16 ± 38.12	775.00	0.325	0.195
9 m shots (%) [a]	57.16 ± 32.89	31.13 ± 26.24	1819.00	<0.001	0.875
Wing shots (%) [a]	70.43 ± 37.98	44.45 ± 39.98	1217.00	<0.001	0.666
Fast-break shots (%) [a]	78.86 ± 35.75	66.18 ± 45.78	608.00	0.256	0.309
Breakthrough shots (%) [a]	72.27 ± 37.48	69.29 ± 40.92	1129.50	0.811	0.076
Yellow cards (n)	0.04 ± 0.19	0.12 ± 0.32	3315.00	0.044	0.304
Red cards (n)	0.14 ± 0.35	0.19 ± 0.45	3515.50	0.628	0.124
2-min exclusions (min)	1.22 ± 1.45	1.88 ± 1.91	2958.50	0.028	0.389
Assists (n)	2.01 ± 1.34	1.32 ± 1.05	2543.00	<0.001	0.573
Technical fouls (n)	1.13 ± 1.10	1.69 ± 1.401	2805.50	0.009	0.714
Steals (n)	0.71 ± 0.94	0.44 ± 0.63	3174.50	0.119	0.337
GB saves (%) [b]	23.38 ± 15.83	38.13 ± 18.77	2066.00	<0.001	0.827
GB 6 m saves (%) [b]	17.65 ± 32.56	20.93 ± 36.75	1072.00	0.813	0.094
GB 7 m saves (%) [b]	24.58 ± 40.65	11.11 ± 30.91	648.50	0.072	0.373
GB 9 m saves (%) [b]	29.86 ± 32.45	55.10 ± 36.00	1952.00	<0.001	1.100
GB wing saves (%) [b]	23.22 ± 36.93	46.43 ± 42.05	1203.50	0.002	0.587
GB fast-break saves (%) [b]	16.13 ± 35.09	20.94 ± 37.99	550.5	0.870	0.039
GB breakthrough saves (%) [b]	22.88 ± 35.41	25.00 ± 38.11	1040.50	0.846	0.614

[a] number of shots converted/number of shots; [b] number of shots saved/number of shots; GB = goalkeeper-blocked, ES = effect size.

Table 4 compares means of game-related statistics for females during the last 10 minutes of balanced games by game outcome (winning and losing) with standard deviations using parametric (t-test) and non-parametric test (Mann-Whitney) with p values and effect sizes. Six variables showed significant differences (alpha level <0.05) depending on the game outcome. Four variables showed large effect sizes (Cohen's d>0.80) between winning and losing teams. In order of decreasing effect sizes the variables were; shots (d = 1.414), GB saves (d = 1.330), 9 m shots (d = 0.933) and GB 9 m saves (d = 0.923).

Table 4. Basic descriptors (mean and standard deviation), unpaired-sample t-test (parametric test), Mann-Whitney U test (non-parametric test), p-value, and the effect size of the differences (Cohen's d) for each variable according to the game outcome in female.

Variable	Winners	Losers	t	U	p	ES
Shots (%) [a]	62.34 ± 17.58	37.94 ± 16.92	7.268		<0.001	1.414
6 m shots (%) [a]	79.32 ± 34.08	76.66 ± 41.69		2549.00	0.872	0.070
7 m shots (%) [a]	70.59 ± 43.51	69.44 ± 42.49		149.50	0.893	0.027
9 m shots (%) [a]	53.06 ± 27.25	27.66 ± 27.14		367.50	<0.001	0.933
Wing shots (%) [a]	40.33 ± 38.77	38.23 ± 41.58		381.50	0.754	0.052
Fast-break shots (%) [a]	82.84 ± 35.41	54.76 ± 45.96		39.00	0.120	0.684
Breakthrough shots (%) [a]	75.60 ± 36.14	64.63 ± 40.30		209.50	0.294	0.287
Yellow cards (n)	0.10 ± 0.30	0.10 ± 0.30		882.00	1.000	0
Red cards (n)	0.00 ± 0.00	0.00 ± 0.00		882.00	1.000	0

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Variable	Winners	Losers	t	U	p	ES
2-min exclusions (min)	0.67 ± 0.95	1.14 ± 1.48		716.00	0.182	0.402
Assists (n)	2.01 ± 1.45	1.32 ± 1.05		539.50	0.004	0.600
Technical fouls (n)	1.57 ± 1.35	2.31 ± 1.72		631.50	0.048	0.497
Steals (n)	0.71 ± 0.94	0.44 ± 0.63		574.00	0.005	0.592
GB saves (%) [b]	24.99 ± 15.52	50.43 ± 22.15	-5.385		<0.001	1.330
GB 6 m saves (%) [b]	16.36 ± 32.89	23.33 ± 41.69		195.00	0.799	0.186
GB 7 m saves (%) [b]	16.67 ± 36.19	26.47 ± 39.99		109.50	0.389	0.257
GB 9 m saves (%) [b]	60.03 ±32.36	32.08 ± 28.02		376.00	<0.001	0.923
GB wing saves (%) [b]	45.08 ± 43.84	53.97 ± 44.12		283.50	0.477	0.202
GB fast-break saves (%) [b]	5.95 ± 22.63	4.17 ± 17.39		880.00	0.968	0.088
GB breakthroughs saves (%) [b]	20.37 ± 33.76	31.48 ± 41.58		210.00	0.378	0.293

[a] number of shots converted/number of shots; [b] number of shots saved/number of shots; GB = goalkeeper-blocked, ES = effect size.

Table 5 shows the results of discriminant analysis (Wilks' lambda, the canonical correlation index, and the percentage of teams correctly classified) for the game outcome by sex during the final 10 minutes in balanced games. The male's predictive model correctly classified 40.4% of games using two selected variables: technical fouls and GB 9 m saves. The dataset did not allow the female's predictive model to be constructed due to too many excluded variables in the stepwise discriminative model.

Table 5. Discriminant analysis models by the game outcome (winning and losing teams) in male and female, giving the percentage correctly classified, Wilks' lambda, canonical correlation index, and variables included in the model by order of selection.

	Men	Female
Percentage correctly classified	40.4	n.a.
Wilks' lambda	0.005	
Canonical correlation index	0.997	
Variables selected	Technical fouls, GB 9 m saves	

GB = goalkeeper-blocked.

Discussion

This study aimed to analyze i) differences and ii) discriminatory variables in game-related statistics between winners and losers in the Icelandic top handball league in balanced games during the final 10 minutes. As expected, the main findings suggest that winners have better shot efficiency and GB saves. Furthermore, shot efficiency from 9 m was significantly better amongst winners than losers, as were GB saves from 9 m. Interestingly, the discriminatory model consisted only of technical fouls and goalkeeper blocked shots from 9 m (classifying 40.4% of games correctly). The model for the female league was impossible to construct due to excluded variables in the stepwise discriminatory model. This study brings value to the current handball performance analysis literature as it is the first to take a closer look at the game-related statistics (20 variables) during an exciting period of the games for the players, coaches and spectators of the sport.

Previous research into the final minutes of handball have been studied (Debanne et al., 2018; Lozano et al., 2016), and the concept of balanced games explored (de Paula et al., 2020; Pic, 2018). One recent study investigated the same game-related statistics on a whole season basis at the domestic league level (Þorgeirsson et al., 2022), rather than the more commonly researched elite level (Saavedra et al., 2017a). In those two papers, the methodology is the same as used in this present work, and thus offers better opportunities to compare this study's results to both whole game outcomes and different competition levels.

Differences between winners and losers for males were found in ten of the 20 analysed variables, of which shots (d = 1.114), GB 9 m saves (d = 1.100), GB saves (d = 0.827) and 9 m shots (d = 0.875) returned large effect sizes. This is in line with findings from recent work on the same league (Þorgeirsson et al., 2022), which found shot efficiency, GB saves and 9 m shots to differ between winners and losers. Compared to results from four past Olympic Games, they have 9 m shots in common but differ on GB fast-break saves, and assists found at the elite level (Saavedra et al., 2017b). There are several possible explanations why the 9 m shot is so important. First, tactically, it could be wise to direct the opponent into the relatively lower chance shot from outside 9 m with a more passive approach than allowing close range shots from 6 m, the wings, or breakthrough opportunities. Second, as the match draws to an end, the defense might take a more passive stance closer to the 6 m line to avoid receiving a 2-minute suspension or 7 m penalty throw. The third is the rotation of outfield players between defense and offense. In a recent study on the elite level, the absolute on-court time for back-court players is less than for wing players (Büchel et al., 2019), giving back-court players more time to recover during matches.

For differences between winners and losers for female league teams, six variables emerge as being significantly different, whereby four of them (shots d = 1.414, GB saves d = 1.330, 9 m shots d = 0.933, and GB 9 m saves d = 0.923) showed large effect sizes. These results are comparable to male variables and highlight the role of goalkeepers and shots from

9 m during the final minutes in balanced games. Previous research on international-level whole game females has indicated that red cards and assists differ between winners and losers (Saavedra et al., 2018). Red cards did not appear in this limited data set and were therefore not calculated. Still, they could be considered to be likely to be a meaningful event at the domestic level as well as elite level. Assists also appear significant (with moderate effect size d = 0.600) in the last ten minutes of balanced domestic games, as was the result at the elite level (Saavedra et al., 2018). Unlike findings investigating balanced games at the elite level, assists were more important in unbalanced games (de Paula et al., 2020). Generally, these results from the final minutes of balanced games share similar characteristics with full game statistics – as observed before in shots, GB saves, and GB 9 m saves, all with large effect size and assists. However, 7 m shots were not identified in this work as before during whole games (Þorgeirsson et al., 2022). There are two reasons for this, first, it is possible that too few 7 m throw events were observed in this study to produce a statistically significant difference. Second, although the efficiency is very similar, the number of 7 m throws awarded might differ between winners and losers and thus affecting the final outcome. Similar to males, the 9 m shots, whether blocked or a goal, seem to be the variable to consider during the final minutes of balanced games for females.

A discriminatory model for males was constructed (Wilks' lambda 0.005 and canonical correlation of 0.997) and interestingly selected only two variables with 40.4% correct classification. Technical fouls and GB 9 m saves emerged from this model, just as those two variables had been selected in a whole game analysis model for a domestic league before, in addition to shots, GB shots, steals, and GB 7 m saves (Þorgeirsson et al., 2022). The results can be compared to the international elite level, where technical fouls also appear with shots, GB saves, and the number of attacks (not analyzed here) (Saavedra et al., 2017a). The fact that technical fouls is the first variable selected in the model should not surprise coaches at the top level or readers of scientific papers about performance analysis at the elite level (Saavedra et al., 2017b).

Unfortunately, after an exploratory analysis, it was impossible to construct a discriminatory model for females based on the dataset assembled from two seasons. It was limited to only games balanced at minute 50 with a goal difference of two or fewer. However, it would have been expected to find shots and GB saves to classify games correctly, as was the case with full games for an entire season (Þorgeirsson et al., 2022). Also, technical fouls, which have been shown to damage teams' chances of winning (de Paula et al., 2020), with steals and GB fast-break saves, have been previously identified in such models at the elite level (Saavedra et al., 2018).

This study has several limitations: i) the sample consists of top domestic leagues and is therefore only representative of that competition level. ii) The nature of the data is static, and with only 10 minutes included for analysis, the sample consists of relatively few events, although comprised of two seasons. iii) The standard situational variables available for this study do not provide details for precise analysis. iv) The cut-off point at 50 minutes could have excluded games that minutes later became balanced (less than a two-goal difference) or included games that were about to become unbalanced for the remainder of the game. At a nuanced level, the most balanced games being excluded from the analysis because they resulted in a draw. The results of this study underline the importance of incorporating process-related data to understand the effects of individual variables on the handball goal-scoring dynamics. Future research must include efforts to better understand the processes behind the outcome statistics covered in this work. They should also consider adding the number of each statistical event into the analysis to understand the weight of each variable better in the context of the final outcome. In conclusion, coaches preparing their teams for the final minutes of balanced games should consider a special tactical preparation for the shots made from outside 9 m when breaking through defenses is challenging, defensively (GB saves) and offensively (shots).

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