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Goal-Scoring Differences Between Male and Female Floorball Players in the Swedish Super League

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Abstract

The aim was to investigate sex differences regarding shooting position, shooting technique, and shot placement preceding open-play goal scoring in the Swedish Super League (SSL) in floorball. Video recordings of 3751 goals were analysed to determine the goal scorers' positions on the pitch when they took the shots and which type of shots they used. In addition, the placement of the ball when it entered the goal was determined. The proportion of goals from the playing zone closest to the goal was higher for women ($P < 0.001$), whereas the relative number of goals from the playing zones to the left of the goal and from the central playing zone farthest from the goal was higher for men (all $P < 0.001$). Women used wrist shots and backhand shots more frequently to score goals than men (both $P < 0.01$); conversely, the proportion of goals scored using slap shots and volley shots was higher for men (both $P < 0.001$). In terms of shot placement, the percentage of goals scored in top-left corner was higher for male players ($P < 0.05$). Hence, there are sex-related goal-scoring differences in SSL and the findings may inform coaches in refining tactics and training.

Keywords: Sex difference, video analysis, unihockey, shooting technique

Introduction

Floorball is a team sport that is played in 3 × 20 min periods on a 40 × 20 m pitch enclosed by a 0.5-m high boards (Swedish-Floorball-Federation, 2022a). The objective of the game is to score goals by shooting the ball into the opposing teams goal using a floorball

stick, and each team has one goalkeeper and five outfield players on the pitch under normal match conditions (Swedish-Floorball-Federation, 2022a). Substitutions are permitted both during active play and at stoppages and players are rarely on the pitch for more than a minute before being substituted (Swedish-Floorball-Federation, 2022b).

Floorball is characterized by frequent variations in movement intensity, requiring players to perform repeated high-intensity sprints while simultaneously performing complex motor tasks such as dribbling, passing, and shooting (Paavilainen, 2007b; Swedish-Floorball-Federation, 2022b). Recently, the Swedish Floorball Federation published a report on the speed and movement dynamics of floorball players in the Swedish Super League (SSL) for men and women based on data collected from matches during the 2017/18 season using a local positioning system (Swedish-Floorball-Federation, 2022b). The average total distance covered by male SSL players were 2835 m for forwards and 2690 m for defenders, whereas female offensive and defensive SSL players cover an average distance of 3210 m and 2839 m, respectively; however, irrespective of the playing position, male players covered a greater distance at running speeds above 18 km/h, with male defenders (193 m) and forwards (270 m) covering more distance than female defenders (106 m) and forwards (175 m) (Swedish-Floorball-Federation, 2022b).

A key tactical element in floorball is the ability to rapidly transition from defensive to offensive play following ball recovery (Kauppi et al., 2018). This transition is often facilitated by a long pass to an unmarked teammate, enabling a quick shot on goal. This strategy is enabled by the absence of an offside rule in floorball (Kauppi et al., 2018). In organized attacks, players run trying to draw the defensive players out of position to create passing and shooting opportunities (Paavilainen, 2007b). The attacking team can take shots from several zones of the pitch using different shooting techniques (e.g., wrist shot, drag shot, slap shot, backhand shot) to score goals (Paavilainen, 2007b). Goals are mainly scored through shots (Kauppi et al., 2018). The type of shot taken depends on various factors, including the specific game situation, offensive objectives, shooting distance, the presence of defenders, and the time available to execute the shot (Gómez, Prieto, Pérez, & Sampaio, 2013; Paavilainen, 2007b).

Analyses of shot origins leading to goals in the men's Floorball World Championships in 2016, 2018, and 2022 indicate that more than 60% of goals resulted from shots taken within the two central playing zones directly in front of the goal (Kauppi et al., 2018; Malina, 2019; Zderčík, 2024). Further analysis of the goal scored showed that the goal scorer was typically under minimal or no defensive pressure at the moment of the shot (Kauppi et al., 2018). Moreover, most common goals were preceded by defensive errors, and the time from ball recovery to the execution of the goal-scoring shot ranged from 1 to 3 seconds (Kauppi et al., 2018).

Regardless of whether a goal results from an organized offensive play or a counterattack, floorball players must have a good passing accuracy to enable rapid shot attempts (Paavilainen, 2007b). Moreover, another crucial aspect influencing success in floorball is shooting efficiency, indicating that less than 20% of the shots that go through the defensive blocks and remain within the goal frame result in a goal (Prieto-Gómez, Pérez-Tejero, &

Gómez, 2013). An understanding of whether male and female players favour different shot types, target specific goal areas differently, or shoot from different positions could help coaches and players develop more effective offensive and defensive tactics and training strategies. However, to our knowledge, no previous research has investigated whether male and female elite-level players shoot from different positions, use different types of shots, and/or target specific goal areas differently when scoring goals during open play (i.e., even strength, power play, or box play goal). Therefore, this study aimed to investigate sex differences regarding shooting position, shooting technique, and shot placement preceding open-play goal scoring in the SSL.

Materials and methods

Video analyses

An observational analysis of the goals scored during the SSL season 2022/23 was conducted to fulfil the purpose of the study. A total of 4040 goals were scored, with 1811 goals in the women's SSL and 2229 goals in the men's SSL. Video clips of match highlights available, through a monthly fee, on a public domain (SportExpressen Play: https://livesport.expressen.se/innebandy/ssl) were used to determine the goal scorer's shooting position and shooting technique as well as shot placement when scoring open-play goals. The videos were analysed by one observer who had 13 years of experience as a floorball player. The observer completed an analysis protocol for each goal and if some of the variables were hard to judge, the match sequence in question was paused and/or replayed to be accurate in determining the player's shooting position, shooting technique and shot placement.

Shooting position

To determine the position on the pitch from where the goal-scoring shot was taken, the offensive half of the pitch was divided into six playing zones from the midline to the extended goal line (Figure 1). The definition of the playing zones was retrieved from previous research studies in floorball (Gómez et al., 2013; Prieto-Gómez et al., 2013). The size of the two central zones (4C and 5C) was 5.00 × 8.25 m, whereas the size of the four outer zones (4R, 5R, 4L, and 5L) was 7.50 × 8.25 m. All goals scored from a shooting position on the defensive half of the pitch and behind the extended goal line were excluded from the statistical analyses.

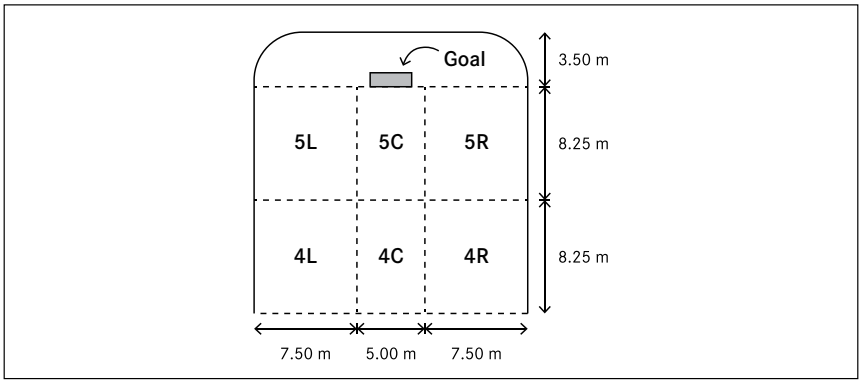

Figure 1 **Overview of the floorball pitch, where the six playing zones in the offensive half are marked out from which the shooting position of the goal scorer is determined**

Shooting technique

The shooting technique for each goal-scoring shot was determined, and the results for the six most common shooting techniques in floorball were used in the subsequent statistical analyses. The types of shots that were included in the analyses were wrist shot (WS), drag shot (DS), slap shot (SS), backhand shot (BS), volley shot (VS), and half-volley shot (HVS). All goals emanating from Zorro shots, penalty shots, shots in an empty goal, or goals preceded by feint of the goalkeeper were excluded from the statistical analyses.

Shot placement

The variable shot placement categorises the position of the ball when it enters the plane built up by the goal frame.

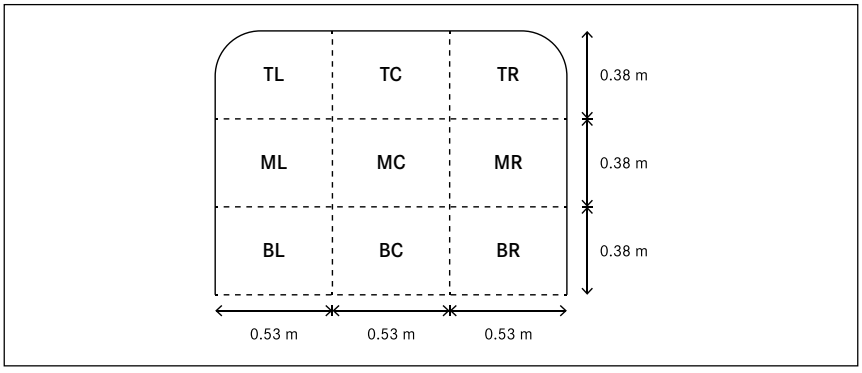

Figure 2 **The goal with nine shot-placement zones indicating the position of the ball when it enters the goal from the players' point of view, where T is top, M is middle, B is bottom, L is left, C is centre, and R is right**

The height of the goal is 1.15 m, and the width is 1.60 m, with a radius of 0.10 m between the goalpost and the crossbar (Figure 2). The goal plane was divided into nine equally-sized shot-placement zones with a combination of horizontal zones (top (T), middle (M), and bottom (B) and vertical zones (left (L), centre (C), and right (R)); for example, the top-left shot-placement zone is abbreviated as TL.

Statistical analysis

To determine sex differences in goal scoring in the SSL regarding shooting position, shooting technique, and shot placement, chi-square (X2) tests for independence were used. If a sex difference was found for a specific category, X2 tests for goodness of fit were used to determine which shooting position(s), shooting technique(s), and shot placement(s) that differed between men and women. Effect sizes were calculated to enable more informative inferences from the results. The phi coefficient (ϕ) and Cramer's V were used for the X2 tests with degrees of freedom equal to 1 or greater than 1, respectively. The substantial effects for ϕ and V were divided into more fine-graded magnitudes as follows: $0.10 \leq \phi$ and $V < 0.30$ corresponded to a small effect size, $0.30 \leq \phi$ and $V < 0.50$ corresponded to a medium effect size, and ϕ and $V \geq 0.50$ corresponded to a large effect size (Cohen, 1988). For all statistical analyses, the results were assumed to be significant at an alpha level of 0.05. The statistical analyses were conducted using IBM SPSS Statistics software, version 29 (IBM Corporation, Armonk, NY, USA).

Results

A total of 3743 goals (men: 2045 goals, women: 1698 goals) fulfilled the criteria that all three variables were possible to identify in the video clip, and it was an open-play goal. Hence, approximately 93% of all goals scored during the 2022/23 women's and men's SSL season were included in the analyses.

Differences in the shooting positions

There was a significant sex-related difference in the distribution of shooting positions when scoring goals in SSL ($X2\,(df = 5, N = 3743) = 37.0$; $P < 0.001$; $V = 0.10$) (Figure 3). The post-hoc tests investigating differences between men and women for specific playing zones showed that there were significant differences for shooting positions 4L ($X2\,(df = 1, N = 196) = 5.89$; $P = 0.015$; $\phi = 0.17$), 4C ($X2\,(df = 1, N = 471) = 8.06$; $P = 0.0045$; $\phi = 0.13$), 5L ($X2\,(df = 1, N = 593) = 3.92$; $P = 0.048$; $\phi = 0.049$), 5C ($X2\,(df = 1, N = 1655) = 18.1$; $P < 0.001$; $\phi = 0.10$). For the former three positions (i.e. 4L, 4C, and 5L), men had a higher proportion of scored goals. Conversely, for the latter position (i.e., 5C), the observed number of goals exceeded the expected count for women. No significant difference between sex was found for the two shooting positions in the right corridor, i.e., 4R ($X2\,(df = 1, N = 175) = 0.13$; $P = 0.72$; $\phi = 0.027$) and 5R ($X2\,(df = 1, N = 653) = 0.92$; $P = 0.34$; $\phi = 0.038$).

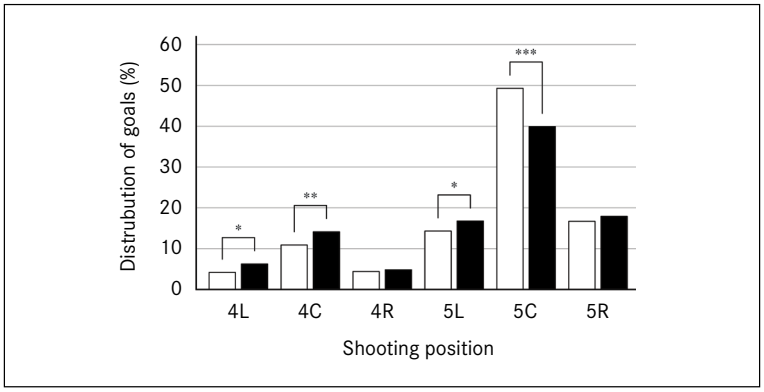

Figure 3 **Distribution of goals for each shooting position, where white and black bars represent women and men, respectively.**

Significant sex-related differences are reported as:
* for P < 0.05; ** for P < 0.01; and *** for P < 0.001

Differences in the shooting techniques

A significant difference in the distribution of shooting techniques used to score goals was found between men and women (X^2 (df = 5, N = 3758) = 65.9; P < 0.001; V = 0.13) (Figure 4).

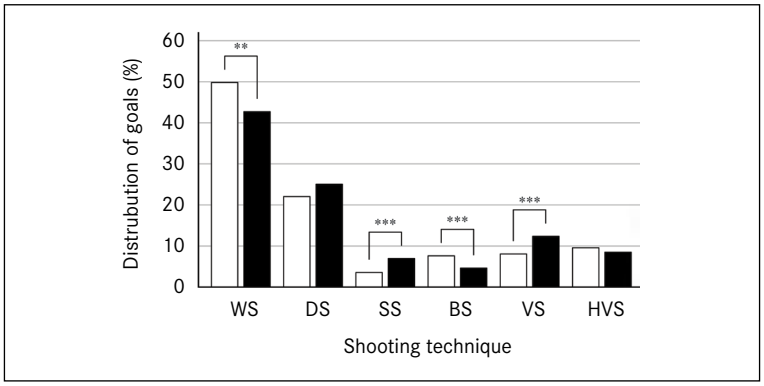

Figure 4 **Distribution of goals for each shooting technique, where white and black bars represent women and men, respectively.**

Significant sex-related differences are reported as:
** for P < 0.01; and *** for P < 0.001

The relative number of goals scored by using WS (X^2 (df = 1, N = 1716) = 10.4; P = 0.0012; ϕ = 0.078) and BS (X^2 (df = 1, N = 223) = 12.1; P < 0.001; ϕ = 0.23) were higher in women compared to men. However, the proportion of scored goals was higher for men than women for SS (X^2 (df = 1, N = 203) = 21.8; P < 0.001; ϕ = 0.33) and VS (X^2 (df = 1,

N = 386) = 16.8; P < 0.001; ϕ = 0.21). No significant sex-related difference was found for either DS (X2 (df = 1, N = 883) = 3.73; P = 0.053; ϕ = 0.065) or HVS (X2 (df = 1, N = 332) = 1.07; P = 0.30; ϕ = 0.057).

Differences in the shot placements

There was a significant difference in the distribution of shot placement when goal scoring of men and women was compared (X2 (df = 8, N = 3758) = 15.7; P < 0.001; V = 0.06) (Figure 5). The proportion of score goals in TL was higher in men than women (X2 (df = 1, N = 553) = 6.51; P = 0.011; ϕ = 0.11). No significant sex-related differences were found for the other eight shot-placement zones (X2 (df = 1, N = 311–530) = 0.00067–3.47; P = 0.98–0.062; ϕ = 0.0016–0.090).

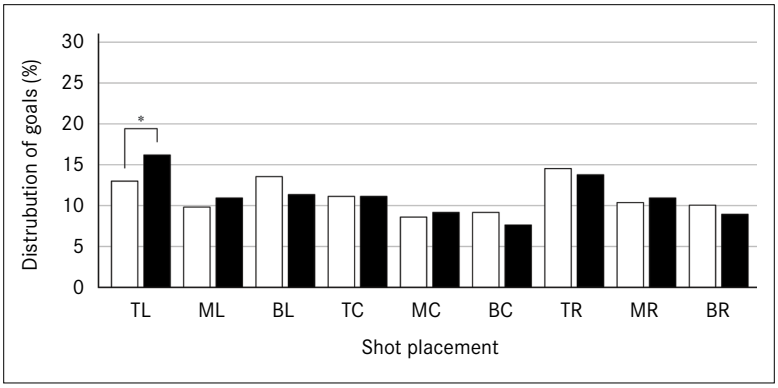

Figure 5 **Distribution of goals for each shot placement, where white and black bars represent women and men, respectively.**
Significant sex-related differences are reported as: * for P < 0.05

Discussion

The current study provides novel insights into the sex differences in goal scoring in elite-level floorball, where sex-related differences in shooting position, shooting technique, and shot placement were analysed. The results of this study demonstrate that there are differences between women and men in all three categories. The proportion of goals scored from the playing zone closest to the goal was higher for women, whereas the relative number of goals from the playing zones to the left of the goal and from the central playing zone farthest from the goal was higher for men. Regarding shooting technique, women used WS and BS more frequently to score goals than men. Conversely, the proportion of goals scored using SS and VS was higher for men. For eight out of nine shot-placement zones, no difference in the distribution of scored goals was found; however, the percentage of goals scored in the TL was higher for male players.

It has previously been suggested that the shooting technique chosen by the player depends on several variables, including shooting distance, time available to execute the shot, and position of the defenders and goalkeeper (Gómez et al., 2013; Paavilainen, 2007b). For both women and men, the highest number of goals was scored from playing zone closest to the goal (i.e., 5C) (Figure 3); this corroborates findings from previous studies that indicate this zone yields the greatest number of goals scored in international floorball matches for men (Gómez et al., 2013; Prieto-Gómez et al., 2013). In the current study, the number of scored goals per shooting position was reduced with increased distance to the goal, where 4L and 4R had the lowest percentage of the total distribution of goals. Together, these results are in agreement with shooting-position statistics from the World Championships for men in 2016, 2018, and 2022, where the greatest number of goals was scored from a shooting position close to the goal (Kauppi et al., 2018; Malina, 2019; Zderčík, 2024). Similarly, the prevalence of goal-scoring by elite male ice hockey players in the Swedish Hockey League was higher for the shooting zone closer to the goal (Lignell, Rago, & Mohr, 2020). Together, these findings suggest that it is important for floorball players to create opportunities to shoot in the playing zone 5C.

It could be anticipated that goal scoring from playing zone 5C does not place the same demands on the speed of the shot compared to the shooting positions further away from the goal. The shooting-position difference related to women's higher percentage of goals scored from 5C is likely a result of their greater use of WS and BS to score goals. These two shooting techniques are considered fast (i.e., a short travelled trajectory of the stick before the ball is hit) and unpredictable for the goalkeeper, respectively (Paavilainen, 2007a); therefore, WS and BS are appropriate techniques to score goals from relatively short distances. The importance of having a short release time to score goals has also been emphasized in ice hockey, where short release time was associated with a higher efficiency than shots with a longer release time (Lignell et al., 2020).

The relative number of goals scored by men from shooting positions 4L, 4C, and 5L was higher than the corresponding percentages for women. As the distance to the goal increases, players tend to rely more on shooting techniques that can generate higher ball speeds. This approach reduces the goalkeeper's time to react and likelihood of saving the shot. The shooting technique SS have been found to generate higher ball speeds than DS and WS (van den Tillaar, 2018). These results are in line with results that SS had higher puck speed than WS in ice hockey independent of sex (Wu et al., 2003). Moreover, skilled male ice hockey players had approximately 50% higher puck speeds than skilled female ice hockey players for both SS and WS (Wu et al., 2003). Correlations between upper-body strength variables and shot speed has been shown in ice hockey (Bezák & Pridal, 2017; Wu et al., 2003). It could be expected that this relationship also is apparent in floorball, where male players are generally able to produce higher stick speeds and thereby higher ball speeds than female players due to a greater strength. Hence, the high ball speed generated when SS is used could explain the findings that men utilize a higher number of SS to score goals and score from a larger distance more frequently than women. Men's greater proportion of VS as the goal-scoring shooting technique is more difficult to explain, but it could

be speculated that elite male players have better eye-hand coordination than elite female players. This speculation is supported by sex differences reported in other sports, where male athletes have been found to have better eye-hand coordination than their female counterparts (Dane & Erzurumluoglu, 2003; Haryanto, Becerra-Patino, & Padli, 2023). The underlying explanation for the sex-related differences that were found in the current study is most likely linked to the physiological and technical differences between elite-level female and male players (Swedish-Floorball-Federation, 2022b); hence, the higher game pace in the men's SSL is most likely reflected by male players' higher running speeds, greater accuracy, and higher ball speeds when passing and shooting.

In all three vertical shot-placement zones, the top zone (i.e., TL, TC, and TR) had the highest percentage of scored goals for both women and men except for women in the left vertical shot-placement zone, where the relative number of scored goals was higher for BL than TL (Figure 5). This exception contributes to the sex difference regarding the distribution of goals scored in TL, where the proportion of goals scored in the top-left corner of the goal was higher for men. In a previous study, it was reported that in international floorball matches between two teams classified as "high-quality teams", the relative number of goals scored using shots categorised as "high shots" was greater compared to matches between teams with different quality standard (Gómez et al., 2013). The shot speeds for SS, DS, and WS were found to decrease when the floorball players aim at a point approximately 0.9 m above the floor compared to an aiming point with a height of 0.1 m; however, the accuracy of the shots was not affected by the target height, shooting technique, or ball speed (van den Tillaar, 2018). The shot accuracy in floorball was found to be significantly better when players looked at the target with their feet pointing towards the goal compared to shots taken with their feet in a parallel position (Lazzeri, Kayser, & Armand, 2016). Hence, to be able to score from a long distance, both accuracy and speed of the object (i.e., the ball in floorball and puck in ice hockey) need to be optimal, as well as release parameters such as shaft flexing and blade orientation (Michaud-Paquette, Pearsall, & Turcotte, 2009). However, irrespective of sex, a substantial portion of the training should be devoted to enhancing shooting speed and accuracy across all types of shooting techniques, thereby improving the players' goal-scoring capacity.

A previous systematic review concluded that there is a scientific lack of knowledge about floorball (Tervo & Nordström, 2014), and the majority of the published studies is within the field of sports medicine. The current study is the first study that has investigated sex-related goal-scoring differences in floorball, thereby contributing to the scientific knowledge and the body literature in the sport. The strengths of the study lie in the large number of goals that have been analysed and its focus on goal scoring in SSL, which is arguably the best floorball league in the world for both women and men. In this context, it is worth noting that the current study analysed only the goal-scoring action from the time of the shot to the time the ball went into the goal. Hence, unsuccessful goal-scoring attempts were not included in the analyses. Consequently, the study's results do not provide an objective assessment of the most effective goal-scoring actions in relation to overall shot attempts. Future studies are warranted to analyse which type of shots should be used

from specific positions on the pitch and where in the goal the player should aim to improve the probability of scoring a goal. Moreover, it would also be of great interest to investigate which actions precede goal scoring. Information from these future studies could, together with the results in the current study, provide valuable knowledge to floorball coaches in their decision of team tactics.

Conclusions

The results of the current study show that there are significant sex-related goal-scoring differences in SSL. The proportion of the total number of goals scored from the playing zone closest to the goal was higher in women, and in line with this finding, it was found that female players used WS and BS to score goals to a higher degree than male players. Male players had a higher proportion of goal-scoring shots from longer distances to the goal, and they also used SS more frequently than women, probably because SS is the shooting technique that could generate the highest ball speeds. No sex-related differences were observed in eight of the nine shot-placement zones. A significant difference between the sexes was found only in the TL zone, where men scored more frequently than women. The findings in the current study may help coaches and players in developing effective offensive and defensive tactics and training strategies.

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