SHOT ANALYSIS OF ELITE WOMEN HANDBALL PLAYERS DURING ORGANISED OFFENSE ATTEMPTS

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ABSTRACT. During the last years and as a result of the recently adopted rules, handball has evolved to a very fast game, with goal-attempts transposing to an important factor influencing the final result of the game. The aim of the present study was to evaluate the performed shots according to a) the total number of attack attempts, b) the adopted offensive formation, c) the positioning of the thrower, d) the final positioning of the ball within the goalpost and e) their efficacy among elite women handball players. All matches of the eight finalists women's National Teams competing at the 2008 Olympic Games, were recorded. The total number of attacks (n=3,264) was evaluated with video-analysis software. Non-parametric Chi-square tests were used to assess differences (p<0.05). The results revealed a variation in the goal-attempt shots positioning inside the court, with the majority being performed in areas with inadequate defence. Among the goal-attempts that reached the goalpost 31.4% were successful, 16.0% were saved by the goalkeepers and 9.8% ended outside the post.

Keywords: handball, women, shot, offense formations; shot positioning; efficacy

Introduction

Handball is a dynamic sport involving body contact between opponents, with a continuous alternate between rapid and slow movements (Amin, Horyd and Bober, 1985). Additionally, it consists of one of the most popular sports in the European continent, with a great number of women participants.

The recently adapted changes concerning the sport's rules have resulted in an accelerated play mode (Christer, 2010). In further detail, the number of goal attempt shots has been significantly increased since the match is resumed immediately after each goal. Hence, goal attempt shots evolved to the most pivotal movements performed among offensive players, requiring skilled efforts involving the whole body of the thrower (Homberg and Papageorgiou, 1995), while consisting of a factor of great importance concerning the final result of the game (Mavridis *et al.,*

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2006; Skoufas *et al.,* 2003). The execution of goal attempt shots is not a "simplistic" offensive movement, but entails complex technical and tactical integrations in order to put an offensive player in a more advantageous position opposite the goal post. On the other hand, goal shooting is highly dependent on proper targeting and execution precision, the velocity of the released ball and the power output needed to disposition the goalkeeper and succeed in scoring (Milanovic, Vuleta and Sisic*,* 2012; Kajtna *et al.,* 2012).

It has been suggested (Kastner, Pollany and Sobotka*,* 1978) that different shooting techniques should be selected depending on the position, timing and distance from the goalpost. However, proper selection of the best technique does not always ensure success, because, irrespectively of the number of defenders, there is also the goalkeeper who is ultimately guarding the post.

Nowadays, in every sport coaches are searching for the parameters and techniques that will boost the chances for winning (Oscar and Pascual*,* 2011). Among team sports, video analysis has been deemed useful in identifying individual weaknesses of each player, evaluating and improving performance through training adaptations and improving technical and tactical knowledge (Mullen, 1992; Yiannakos, 2005; O'Donoghue, 2006).

On the other hand, recording, studying and analysing the components of large-scale sports events through video analysis has also provided data concerning the evolution of the playing characteristics of each sport. Such data are extremely useful to both coaches and players, in providing information on the playing characteristics and behaviour of elite teams, as well as in identifying the modern playing trends prevailing in each sport (Sampaio and Janeira, 2003; Taylor, Mellalieu and James, 2004; Zakas *et al.*, 2002). As far as handball is concerned, the recent adaptation of new playing rules and the similar ratio in sports participation between the two sexes (Taborsky, 2008), provided a chance to re-evaluate specific playing indexes.

Thus, the aim of the present study was to assess the performed shots in relation to a) the total number of offensive phases, b) mode of adopted offense, c) positioning of the thrower, d) final positioning of the ball within the goalpost and d) the efficacy of the performed shots among elite female handball players.

Material & methods

Sample

The sample consisted of eight elite women handball national teams competing at the 2008 Olympic Games in Beijing, China. All the games of the eight finalist teams were recorded and the offensive attempts were analysed, involving a total of 3,264 phases. The shots performed by each team, on every match were evaluated thoroughly.

Procedure

The Sport-Scout video analysis software was used to analyse the phases, using a handball-specific standardised observation and record protocol. The observer has the ability to input important aspects of the play in the software and analyse them using a P/C.

In further detail, the protocol involved the record of all shots performed during different offensive formations (either organised or fast-break), the positioning of the thrower, their efficacy (goal/saved/or out), as well as the final positioning of the ball within the goalpost, such as the height and side of the post.

Statistical Analyses

The 19th version of the Statistical Package for Social Sciences (SPSS Inc., Hong Kong) was used for data analyses. Crosstabs was applied and statistically significant differences were observed with the non-parametric Chi-square test. Significance was set at 5%.

Results

The analysis identified 3,264 offensive phases (Fig. 1), with 94.6% of those being completed (n=3,088) and the remaining 176 being incomplete mainly due to player errors (X^2=159.132, p=0.000).
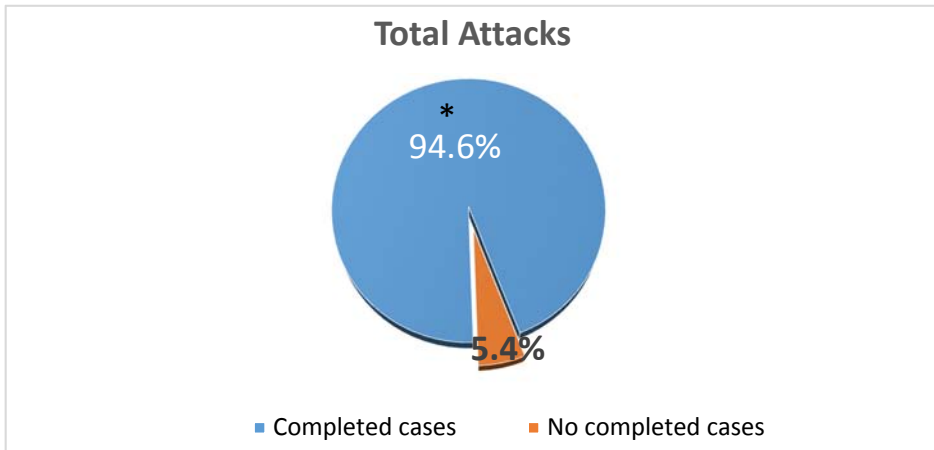

Fig. 1. Rates of attack attempts and non-completed attacks
*Attack attempts *vs.* non-completed attacks (p=0.000)

Among the total number of attack attempts, a great majority involved shots (66.9%) whereas a lower percentage was completed without involving shots (33.1%), (X^2=22.848, p=0.000) (Fig. 2).
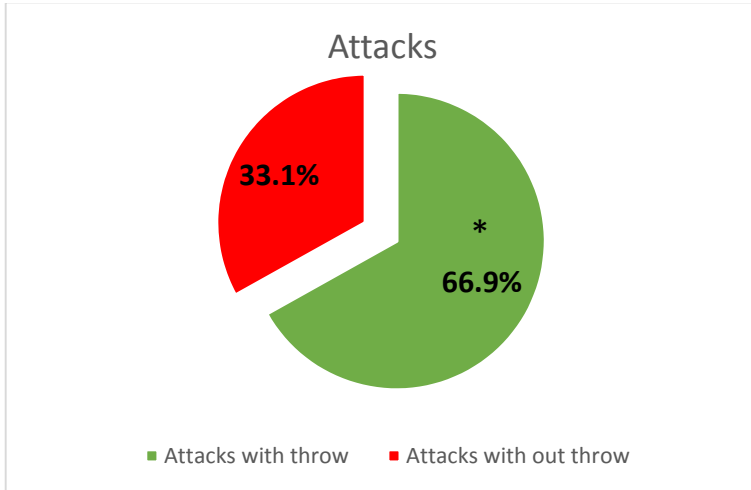

Fig. 2. Prevalence of attacks with and without goal-attempt shots
Attacks with goal-attempt shots *vs.* attacks without goal attempts shots (p=0.000)

The majority of the attacks (78.0%) were performed during organised offensive efforts, whereas a statistically lower percentage (16.6%) involved fast-break attacks (x^2=75.619, p<0.000). The latter consisted mainly of second wave (11.4%) and first wave attacks (5.2%) (Fig. 3).
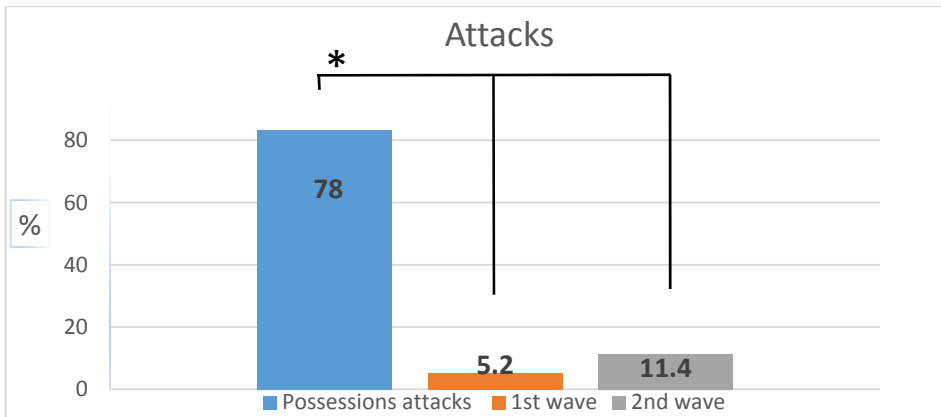
Fig. 3. Possession and fast break attacks
*Possessions attacks *vs.* fast breaks (1st & 2st wave) (p=0.000)

As seen in Figure 4, shot attempts during organised offense possession were performed mainly from the periphery of the court (40.8%), with a lower percentage originating 6m from the goal post (26.4%), 15.9% being shot from the wings and the remaining 11.5% consisting of 7m throws. Data analysis revealed a statistical difference between shots originating from the periphery *vs.* those from the 6m (X^2=4.647, p<0.03), wing-throws (X^2=15.261, p=0.000), as well as with the 7m throws (X^2=22.227, p=0.000). Additionally, the shots thrown from the 6m line were significantly different compared to the 7m throws (X^2=7.227, p=0.000), whereas no difference was observed among wing-throws, despite the difference recorded in their prevalence (X^2=3.305, p<0.06).
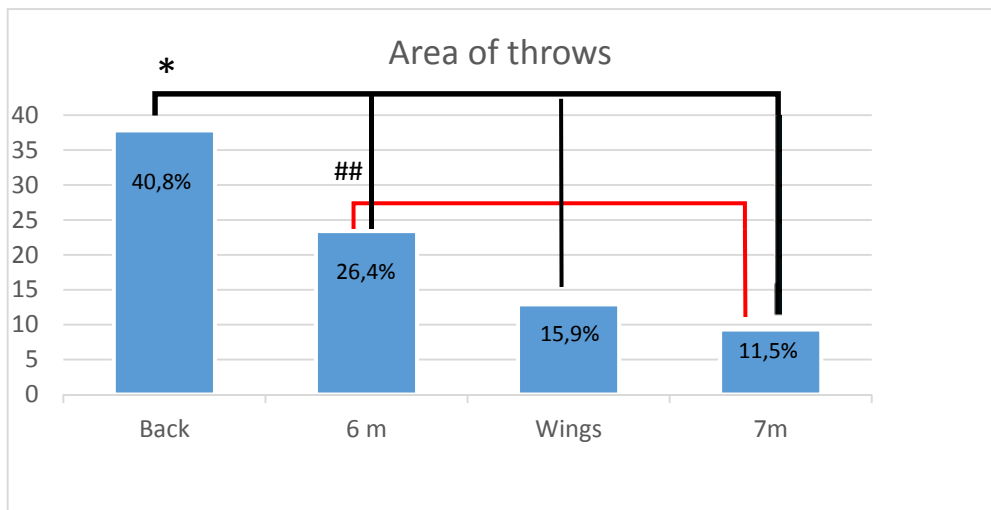

Fig. 4. Percentage of shots depending on the throwing position
* Back area throws *vs.* 6m, wing and 7m. throws; ## 6m throws *vs.* 7m. throws
(p=0.000 for all)

As stressed in Figure 5, the majority of the goal-attempt shots performed during organised offensive formations reached the goalpost (56.7%), with a mere 37.4% being unsuccessful. Among those that reached the goalpost, 31.4% ended in successful scoring, 16.0% were saved and 9.8% were misplaced. Attempted shots that failed to be executed were either interrupted from fouls (28.1%), considered penalties (5.7%), or blocked by the opponents' defence (3.6%). The statistical analyses revealed a significant difference among shots that reached the goalpost, compared to the unsuccessful ones (X^2=7.863, p<0.005), between the successful goals and the goalkeepers' deflections prevalence (X^2=5.733, p<0.01), as well as between successful and unsuccessful goals (X^2=13.733, p=0.000). Comparison of the fouls to the penalty charges and the defence-blocked attempts also revealed

statistical differences (X^2=17.863, p=0.000 and X^2=22.501, p=0.000, respectively). No difference was observed between the prevalence of goals and fouls (X^2=0.188, p<0.664).
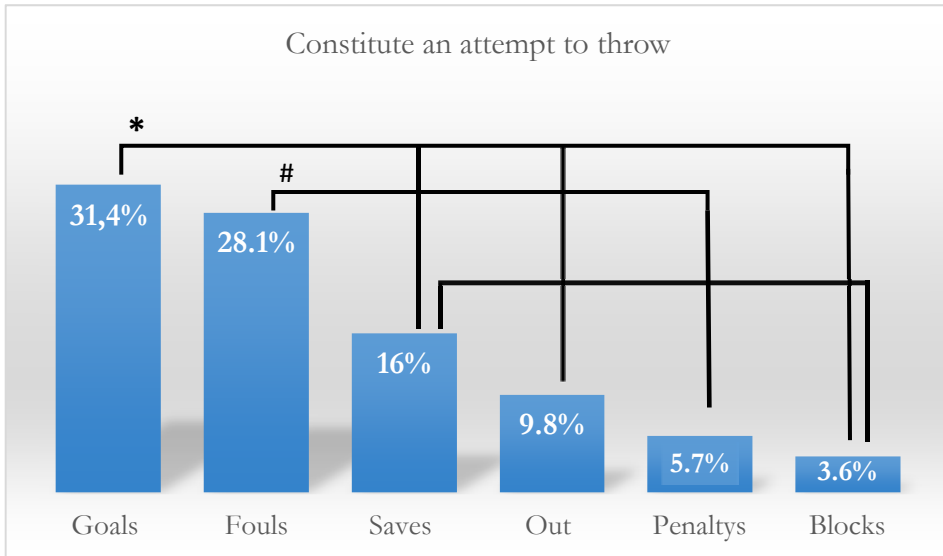
Fig. 5. Shot result, according to prevalence
*Goals *vs*. saves, outs and blocks; #Fouls *vs.* penalties; *#Saves *vs*. outs and blocks.
(p=0.000 for all)

Examination of the goal-shots' height revealed that the vast majority consisted of high-shots (46.4%), 41.7% were low-shots and a smaller percentage involved medium-height shots (11.9%) (Fig. 6). The statistical analysis showed a difference between the number of high and medium-height shots (X^2=26.510, p=0.000). As far as the side of the goalpost is concerned, most of the shots ended on the right side (45.2%), fewer on the left side (32.3%), and the remaining on the centre of the goal (22.5%). The amount of goal-shots ending on the right side of the goalpost was significant greater compared to those aiming in the middle (X^2=11.506, p=0.000) and the left side of the post (X^2=3.505, p<0.06). No difference was observed between the number of goal-shots aiming the left and the middle of the goalpost (X^2=2.413, p<0.120).

Among the goal-shots that ended inside the goalpost, the majority was positioned on the right side of the post (30.6%), a smaller ratio had aimed on the left side (21.5%) and an even smaller percentage involved shots in the middle of the goalpost (11.3%), with the differences between the right and left axis being statistically significant (X^2=11.246, p=0.000).

Total		L	C	R
** 46,4%	H	13,5	10	22,9
11,9%	M	4,5	3,5	3,9
** 41,7%	L	14,3	9	18,4
100%		32,3%	22,5%	* 45,2%

Fig. 6. Shot result in reference to the height and width of ball positioning within the goalpost
*Right and Left areas *vs.* Middle area; High and Low areas *vs.* middle areas (p=0.000 for both)

Additionally, the observed differences between the left side and the middle of the goalpost were also of statistical importance (X^2=3.794, p<0.05), whereas no differences were observed between the number of goal-shots positioned on either the right or the left side of the post (X^2=2.149, p<0.142). The majority of successful goal-shots aiming on either side of the post landed either on the upper (28.4%) or lower points of the goal (27.8%), with a smaller number (7.2%) ending on the middle height of the goalpost.

As seen in Figure 7a, the difference between upper and lower sides of the goalpost compared to the middle was statistically significant (X^2=15.358, p=0.000 and X^2=14.696, p=0.000, respectively).

Figure 7b stresses the goal-attempts that were saved, most of which took place on the right side of the goal (14.6%) compared to the middle (11.2%) and the left side (10.8%). The statistical analyses did not reveal differences between the observed saves within the different goal sides (X^2=0.514, p<0.473 for the right, X^2=0.008, p<0.927 for the middle and X^2=0.651, p<0.419 for the left side of the post, respectively).

According to the results, the saves were greatly affected by the height of the shots (Fig. 7b). The majority of goal-shots were fended-off on the upper (18.0%) and the lower part of the goalpost (13.9%) and fewer were saved while at middle height (4.7%). Although no difference was observed between higher and lower shots (X^2=0.626, p<0.428), goal-shots of middle height were fended-off in smaller percentage compared to the higher (X^2=8.790, p<0.0.03) and lower throws (X^2=5.017, p<0.025).

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Goals (7a)

Total		L	C	R	
* 28,4%	H	9,0	3,7	15,7	
7,2%	M	3,0	1,6	2,6	
# 27,8%	L	9,5	6	12,3	

63,4% 21,5% 11,3% * 30,6%

Saves (7b)

Total		L	C	R	
* 18%	H	4,5	6,3	7,2	
4,7%	M	1,5	1,9	1,3	
# 13,9%	L	4,8	3,0	6,1	

36,6% 10,8% 11,2% 14,6%

Fig. 7. Efficacy of the shots, regarding successful scoring or save from the goalkeeper, in reference to the height and width of the goalpost.
*Right and Left areas *vs.* middle area; #Higher and Lower areas *vs.* middle areas (p=0.00 for all)

Discussion

The present study analysed the general characteristics of goal-attempt shots performed by elite women handball players, members of National teams. Undeniably, the goal-attempt shots consist of the most important technical element moulding the final result of a handball match. In the study herein, this technical element was studied in association to different offense formations, the positioning of execution and the final positioning of the ball within the goalpost.

The analysis revealed that the majority of offensive attempts were successful (94.6%), with a very small prevalence of unsuccessful ones, due to player errors or other causes (5.4%) a same percentage of attacks was recorded to Pournara (2012). However, among the successful attempts, only 66.9% ended with a goal-attempt shot, whereas the remaining 33.1% were interrupted due to fouls or other reasons. During the 2006 women's ECh, a lower percentage of successful attacks (86.0%) was recorded (Aagraard, 2007).

The results showed that among the total number of offensive phases, a great majority involved organised attacks (78.0%). This is in full compliance to Hianik (2007) who reported that organised offense counted for 80.0% of the cases during the 2007 women's ECh. Among these attempts, fast-break 1st and 2nd wave attacks involved a low percentage (17.6%). Similarly, Aagaard (2007) reported that 18.2% of the organised offense attempts involved fast-break attacks during the 2006 women's ECh, whereas Arvidsson and associates (2002), recorded a higher prevalence during the 5th women's ECh (23.4%). These discrepancies in the fast-break attacks could be attributed to a more successful opponent defence, or even to a greater prevalence of unsuccessful shots performed during organised attacks. In agreement to Hianik (2007), the results herein showed that among the fast-break attacks, 1st wave attacks involved a lower percentage (5.7%), whereas 2nd wave attacks were more prevalent (11.9%).

As far as the positioning of the thrower is concerned, the majority of the shots were performed from the periphery of the court (40.8%) (center, left and right backcourt), fewer were performed from a 6m distance (26.4%) and even fewer from the wings (15.9%) and the 7m position (11.5%). Ohnjec *et al.* (2008) reported a higher prevalence of back shots (52.5%) during the 2003 WCh in Croatia, whereas according to Hianik (2007), during the 2006 ECh the mean goal-attempt shots from the back of the court reached 35.0%, a ratio significantly greater compared to the wing-shots (18.0%).

From the attempts shots, a great majority reached the goalpost (57.2%) and were either successful, deflected or out, whereas 37.4% of the attempts were interrupted due to a variety of reasons (fouls, penalties, blocks). As far as the goal attempts are concerned, 31.4% of those were successful, 16.0% were deflected by the goalkeepers and 9.8% were unsuccessful. Aagaard (2006) examined women competing in the ECh and reported fewer successful goal-shots during the years 2006 (26.7%) and 2004 (27.0%). Additionally, she recorded a greater prevalence of fend-offs (35.0%) compared to the present study. Similarly, according to Krokhin (2003), women participating at the ECh were successful in fending-off by 33.0%.

The percentage of shot-attempts that were interrupted due to fouls reached 28.1%, those with fouls and additional penalty charges involved 5.7%, whereas blocking by the opponent's defence was successful in 3.6% of the cases.

A similar blocking prevalence (2.6%) has been reported by Aagaard (2006) during the 7o women's ECh, but a greater number (12.0%) was recorded during the 2003 women's ECh (Krokhin, 2003). As far as 7m throws are concerned, they involved 6.6% of the shot-attempts herein, in contrast to 9.3% suggested by Macovei (2004) during the 2004 ECh. The vertical distribution of the shots landing inside the goalpost involved high-shots (46.4%), low-shots (41.7%) and fewer medium-height-shots (11.9%). As far as the horizontal distribution is concerned, most of the shots landed either on the right or the left side of the goalpost (45.2% and 32.3%, respectively), whereas 22.5% reached the middle of the goal. A greater prevalence of right/left sided goals was reported in the women's ECh (Hianik, 2007) (39.0/47.0%), with an even smaller ratio concerning shots that landed in the centre of the goal (5.0%). However, the same study revealed a lower number of high-shots (34.0%) and a relatively higher prevalence of low-shots (49.0%), with the remaining 18.0% being medium-height shots. These differences could be either the result of an enhanced goalkeeper efficacy regarding low-shots or in some cases, mistakes on behalf of the shooters. Another explanation could be the tactic followed by the defence players of the opponent teams, who, in cooperation with the goalkeeper "forced" the shooter to aim to a specific angle, side or even spot, within the goalpost.

Conclusions

The study herein reveals a deviation among shots performed from different positions within the court, possibly due to the fact that the majority of shots are initiated at the areas with less occupancy from the opponent's defenders. Additionally, the far left and right defenders adopted a pressing style of play towards the wingmen, aiming to increase their domination at the court's wings. This could be the reason for the relatively high prevalence of wing-throws. According to Krokhin (2003), shot efficacy equally depends on the amount of preparation performed during the training sessions and the space left from the opponent's defence in order to perform the goal-attempts.

As far as goalkeeper's efficacy is concerned, we conclude that any observed variability is attributed to the different offensive formations adopted, as well as to the personal ability to fend-off goal-shots performed from different positions within the court.

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