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Throwing Effectiveness per Throwing Area and Playing Position among High Level Handball Players

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Abstract

Match analysis and evaluation helps to increase team overall performance, by contributing to the coaching process. Throwing efficiency is an important factor determining the final result. The aim of this study was to analyze throwing effectiveness by shooting area and by playing position among high-level athletes. The sample consisted of 25 handball games analyzed for throwing efficiency. For the statistical analysis, descriptive statistics and x^2 test were used. The average throw per game was 42.36 ± 6.9 and 56.9% of the total throws, ended successfully. The larger number of throws were made from the central attack area and from a medium distance (6 - 9 meters) with an efficiency of 63.2%, to the left side of the goal at a low height. Test x^2 showed that at the same distance (6 - 9 meters) throwing efficiency in the central area of the attack (center back player position) had a significant difference comparing to the left side of the attack (left back player position) $p < .001$ and a significant difference with the right side (right back player position) $p < .01$. In conclusion, the efficacy of throwing among different attacking areas and player positions, from the same distance, exhibits heterogeneity.

Keywords: handball, analysis, effectiveness, throw.

1. Introduction

People in team sports (Federation, coaches, players, etc.) need scientific help to increase team performance, and to some extent, the total upgrade of championships. One way to achieve this, is to evaluate the games or even the entire championship or cup tournaments. With this process a general evaluation of the sport can be made and, in addition, the participants can be ranked, assessing their failure or success (Bilge, 2012). In team sports, success to some point is predicted through team performance research, which comes from the analysis of athletic performance (Debanne& Laffaye, 2017). As Bilge (2012) says, in modern sports science, motion and training is evaluated through performance assessment. This is because the evaluation and calculation of performance assessment plays an important role for the coaches who are called to plan the coaching process and their plans for the game.

Particularly in handball, throwing is probably the most important action of a player, whose aim is to achieve greatest efficiency (Van Muijen, Joris, Kemper & Van Ingen Schenau, 1991). In addition, the final result of a match depends on the greater number of goals scored by the players of a team, from whom, a high throwing speed is required to overcome the goalkeeper's barrier (Marques, van den Tilaar, Vesca, & Gonzalez-Badillo, 2007). Therefore throwing is a fundamental and basic skill, a handball player has to develop to improve his performance. The main factors affecting the throw in handball are accuracy and speed (van den Tillaar& Ettema, 2004; van den Tillaar& Ettema, 2003a; van den Tillaar& Ettema, 2003b).According to what several studies have shown, average throwing sometimes is the same for the winning and defeated teams and sometimes varies. Thus Gruic,Vuleta& Milanović (2007), report that in the qualifying stage of the 2003 World Championship, both the winning and the defeated teams had the same median but with different efficiency (62.25% winningteams vs 44.3% defeated teams).

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On the other hand Ohnjec,Vuleta, Milanović& Gruić (2008), report that in the women's world championship in 2003, the winning teams had an average of 3.55 more throws comparing with the defeated teams, also having greater efficiency in these attempts (61.31% vs 43.33%). From the above it seems that what is important in a throw is its effectiveness, which ultimately leads to victory.

Taking into account many different aspects of the sport, handball in Greece is not very well developed (Mavrikou, 2015). Nevertheless, the recent and up-to-date overview of the statistics of the championships in the Greek territory helps and contributes to the European and World Indices in order to better understand the individual elements of the games, both in Greece and abroad. Moreover, both the image and the performance of a national team in a sport can be affected by the competitiveness of the championships (Meletakos, Noutsos, Manasis& Bayios, 2014). To summarize, we would say that in order to achieve all the above it is necessary to perform regularly in each season of competition an analysis on specific indices that are recognized as reliable worldwide. This also led to the aim of this study, which was to analyze the effectiveness of throwing per area and per playing position among high-level handball players.

2. Methodology

The sample of the study was 25 high-level handball matches for men's handball championships in Greece, which took place between 2017-2018 and 2018-2019. The method followed was video-analysis. In total, 13 teams who played matches at home and away were evaluated. Study's variables that have been recorded and then analyzed were attack variables and defense variables. In particular, attack variables were: 1. throwing efficiency from 6 to 9 meters (throws <from 6m., goals <from 6m., throws from 6m. to 9m., goals from 6m. - 9 m., throws> from 9 m., goals> from 9 m.), 2. result of the throw (goal, post-out, save) 3. the direction of throwing (direction of throw in the low, medial, upper, left, center and right position of the goal), 4. the distance from the goal (throws from near <6m., middle 6-9m. and long distance> 9m.). Defense variables were the goalkeeper's saves.

2.1. Statistical analysis

For the purpose of this study's statistical analysis, descriptive statistics and the non-parametric method x^2 were used. More specifically, the frequency of values and their percentage were used, as well as the mean and standard deviation (SD). In addition, the differences among distance throws in relation to their effectiveness (goals) from the different shooting areas and the players' positions were examined and analyzed with the x^2 test. The significance level was set at 0.05. Statistical processing of this study's data, was made with SPSS 22.

3. Results

From the results it appeared that the average shooting of the teams per game was 42.36 ± 6.9 throws. Home teams in 25 games made 1049 throws. Hosted teams made 1069 throws. Table 1 shows the total amount of throws from all teams, the result of these throws and their respective percentages.

Table 1. Total throws and their final outcome.

Throwresult	Teams	Percentage
Variables	Frequency	%
Goals	1206	56.9
Saves	629	29.7
Outof goal	170	8.1
Post	113	5.3
Total	2118	100

In addition data analysis reveals that, most attempts were made by right-handed players. More specifically, from the overall 2118 throws analyzed, an amount of 1442, were performed by right-handed players, while the remaining 676 throws were performed by left-handed players.

The right-handed players scored 820 goals (56.9%), 437 throws were saved by the goalkeeper (30.3%), 110 throws went out of the goalposts (7.65%) and 75 throws went to the goalpost (5.2%). The left-handed players scored 386 goals (57.1%), 192 of their throws were saved by the goalkeeper (28.4%), 60 went out of the goalposts (8.8%) and 38 hit the post (5.7%). Table 2 shows the throwing attempts and their outcome by all the players of the teams, with their respective percentages.

With regard to the throwing area and in particular to the exact point where the throws were made by the players, it appeared that most of the throws were made from the central area of the court and in particular from a medium distance, i.e. between 6 and 9 meters. Table 2 shows the frequency values of the throwing distance and the area (point of the playing court) from which these throws came for the total number of the teams involved.

Table 2. Distance and area of throwing of all teams

Court area	Distance< 6 meters	Distance 6 – 9 meters	Distance> 9 meters
Variables	Frequency	Frequency	Frequency
Leftcorner	112	42	3
Leftside	99	157	132
Centralarea	246	416	274
Rirghtside	153	191	119
Rightcorner	150	22	2
Total	760	828	530

Even with regard to the specific direction of the ball in the goal(i.e. the accuracy of the throw), from the results of this research it appeared that taking in account all the teams, the direction of the ball was, most of the times, in the left side of the goal and at a low height. Table 3 shows the frequency of values concerning the direction of the ball towards the goal and the exact point (height) among the teams studied.

Table 3.Goalpost area and height of throwing among teams

Height	Left side of the goal	Centre of the goal	Right side of the goal
Variables	Frequency	Frequency	Frequency
High	189	109	191
Middle	311	91	249
Low	344	100	251
Total	844	300	691

In addition, the results showed that most goals from all teams were achieved from the central area of the court from short, medium and long distance. Table 4 shows the frequency of the goals per area and per distance.

Table 4. Throwing effectiveness (goals) among all teams per attacking area and distance

Court area	Goalsfrom distamce< 6 m.	Goals from distance 6–9 m.	Goal from distance> 9 m.
Variables	Frequency	Frequency	Frequency
Left corner	56	26	1
Left side	64	92	63
Centralarea	158	263	141
Rirghtcorner	91	89	57
Rightside	90	15	0
Total	459	485	262

Test x^2 showed that for the total amount of the games analyzed there were significant differences in areas of the attack and hence in the players' positions, in terms of throwing efficiency and distance. Table 5 shows the significant differences from test x^2 from the distance <6 meters.

Table 5. Differences in frequency and significant differences from the x^2 test in attacking areas, with regard to throwing efficiency from the distance<6 meters.

Court area	< 6 m.	< 6 m.	< 6 m.	< 6 m.	< 6 m.
Variables	Leftcorner	Leftside	Centralarea	Rightside	Rightcorner
Leftcorner	56 vs 56	56 vs 64(ns)	56 vs 158*	56 vs 91(ns)	56 vs 90(ns)
Leftside	64 vs 56 (ns)	64 vs 64	64 vs 158(ns)	64 vs 91(ns)	64 vs 90(ns)
Centralarea	158 vs 56*	158 vs 64(ns)	158 vs 158	158 vs 91**	158 vs 90*
Rightside	91 vs 56 (ns)	91 vs 64 (ns)	91 vs 158**	91 vs 91	91 vs 90 (ns)
Rightcorner	90 vs 56 (ns)	90 vs 64 (ns)	90 vs 158*	90 vs 91 (ns)	90 vs 90

Note. * 0.05, ** 0.01, *** 0.001, (ns) no significant

Table 6 shows the significant differences from test x^2 from the distance of 6-9 meters.

Table 6. Differences in frequency and significant differences from test x^2 in attacking areas with regard to the effectiveness of throwing from the distance of 6 to 9 meters.

Court area	6 - 9 m.	6 - 9 m.	6 - 9 m.	6 - 9m.	6 - 9 m.
Variables	Leftcorner	Leftside	Centralarea	Rightside	Rightcorner
Leftcorner	26 vs 26	26 vs 92(ns)	26 vs 263(ns)	26 vs 89 (ns)	26 vs 15 (ns)
Leftside	92 vs 26 (ns)	92 vs 92	92 vs 263***	92 vs 89 (ns)	92 vs 15 (ns)
Centralarea	263 vs 26 (ns)	263 vs 92***	263 vs 263	263 vs 89**	263 vs 15 (ns)
Rightside	89 vs 26 (ns)	89 vs 92 (ns)	89 vs 263**	89 vs 89	89 vs 15 (ns)
Rightcorner	15 vs 26 (ns)	15 vs 92 (ns)	15 vs 263(ns)	15 vs 89 (ns)	15 vs 15

Note. * 0.05, ** 0.01, *** 0.001, (ns) no significant

Table 7 shows the significant differences from test x^2 from the distance> 9 meters.

Table 7. Differences in frequency and significant differences from the x^2 test in attacking areas, with regard to throwing effectiveness from a distance> 9 meters.

Court area	> 9 m.	> 9 m.	> 9 m.	> 9 m.	>9 m.
Variables	Leftcorner	Leftside	Centralarea	Rightside	Rightcorner
Leftcorner	1 vs 1	1 vs 63(ns)	1 vs 141 (ns)	1 vs 57 (ns)	1 vs 0 (ns)
Leftside	63 vs 1 (ns)	63 vs 63	63 vs 141*	63 vs 57(ns)	63 vs 0 (ns)
Centralarea	141 vs 1(ns)	141 vs 63*	141 vs 141	141 vs 57*	141 vs 0(ns)
Rightside	57 vs 1 (ns)	57 vs 63 (ns)	57 vs 141*	57 vs 57	57 vs 0 (ns)
Rightcorner	0 vs 1 (ns)	0 vs 63 (ns)	0 vs 141 (ns)	0 vs 57(ns)	0 vs 0

Note. * 0.05, ** 0.01, *** 0.001, (ns) no significant

More specifically:

From a distance of <6 meters:

The goals scored from a distance of <6 meters in the left corner of the attack (the position of the left winger) had a significant difference with the goals scored <6 meters from the central area of the attack (mainly line player position) $p = 0.027$.Still the goals scored from a distance of <6 meters in the central area of the attack (mainly the position of the line player) had a significant difference with the goals scored <6 meters from the right side of the attack (position of the right back but also of the line player) $p = 0.008$.

Finally, the goals achieved by a distance of <6 meters in the central area of the attack (position of the line player mainly) had a significant difference with the goals scored <6 meters from the right corner (position of the right winger) $p = 0.021$.

From the distance of 6 - 9 meters:

The goals scored from 6 to 9 meters from the left side of the attack (position of the left back) had a significant difference with the goals scored from 6 - 9 meters from the central area of the attack (position of the center back) $p = 0.000$. Also the goals scored from 6 - 9 meters from the central area of the attack (position of the center back) had a significant difference with the goals scored from 6 - 9 meters from the right side of the attack (position of the right back) $p = 0.002$.

From the distance > 9 meters:

The goals achieved from a distance of> 9 meters from the left side of the attack (position of the left back) had a significant difference with the goals scored> 9 meters from the central area of the attack (position of the center back) $p = 0.028$. Finally, the goals achieved by a distance of > 9 meters from the central area of the attack (position of the center back) had a significant difference with the goals scored> 9 meters from the right side of the attack (position of the right back) $p = 0.036$.

4. Discussion

In relation to the total throws per game, there was an increase comparing the results of this study with those found by Hatzimanouil, Giatsis, Kepesidou, Kanioglou&Loizos(2017). Thus, from the period 2013-1015 until today in the Greek Championship there was an increase of 1.87%. This means that probably the speed of the game have increased, resulting in an increase in the total amount of throws in the game. Furthermore, as Pokrajac (2010) says, the game tends to become faster, more interesting and with more attractive attacks, meaning more goals than before. The number of goals is an important quality criterion and is a basic feature of modern handball. The results of this study agree with the results of A Gomez, Lago-Peñas, Viaño and González-Garcia (2014), which report 44 throws for middle-level teams in the Spanish championship. Meletakos, Vagenas and Bayios (2011), report that throws among high-level teams range from 50.3 ± 3.2 to 52.5 ± 3.1 per match. These values in relation to the values of the present study are due to the different quality of the players and the level of the championship. As it is well known, Greece has a low-quality championship and, by extension, low-quality players.

Still from the results of the study it appeared that out of total throws 56.9% were goals. These results are consistent with those of other researchers such as A Gomez et al. (2014), which found the same percentage (56.9%). A slightly smaller percentage is reported by Hatzimanouil et al. (2017), declaring an efficacy rate of 54.1%. About the same number (54.21%) came from Foretić, Rogulj and Trninić (2010). Higher efficiency but at very high level teams (World Championship) found Ohnjec et al. (2008), which reported a throwing efficiency in the winning teams 61.31% and in the defeated 43.33%. However, the percentage found in the qualifying round for all teams was 52.46%. A similar percentage was found in the research by Gruic et al. (2006), who found an efficiency rate of 53.22% again in high-level teams (World Championship). From the above, we understand that the effectiveness may also depend on the team level, the quality of the championship and the overall difficulty in achieving a goal (goalkeeper-defense). Bilge (2012), reports that between Olympics, World and European Championships there are no significant statistical differences in throwing efficacy,while these throws varies between 49% to 67%.

With regard to the overall throws made, from the results, 68% of the total throws were performed by right-handed players, while the remaining 32% were left-handed. This is logical due to the fact that most handball players in Greek teams in general are right-handed and the use of left-handed players in the right-wing and right-back positions is rational in recent years. That is, left-handed players are mainly used in these positions. Moreover, the effectiveness of both the right-handed player and the left-handed fluctuates between rates of 56.9% and 57.1% respectively.

Most of the throws (416) for all teams were made from the central area of the attack and from a medium distance (6 - 9 meters). Usually in this area of the attack are moving the players of the back positions and especially the center back player. In the same area, the line player also moves, who cooperates with the back players.

In fact, most efforts are being made in this sport in this area of the attack, because in this part of the attack there is the biggest throwing angle and therefore the best conditions for an attempt to succeed. Although in the results of Hatzimanouil et al. (2017), is reported that back players make their most effort (65.6%) from 9 meters and longer distances, however it seems that the central part of the attack and from a medium distance,is the part with the most throwing efforts.

The center back player has the advantage due to its position to catch the ball most of the time, to move in a variety of ways by moving parallel and vertical to the defense and thus to have more opportunities for throwing (Hatzimanouil et al., 2017).

On the other hand, as reported by Spate (2005), attempts from the line player (usually moving in this area) are the most successful of all the attack players. Gruic et al. (2006), report that the line player plays an important role in the success of a high-level team. As reported by Meletakos et al. (2011), the defense attempting to repulse the action from the line player (mainly in the central part) allows back players to make many throws from 9 meters and longer distances. In this way, the existence of high-level back players that are good shooters gives the chance to the attack, and in particular to these players, in addition to shooting, to be able to co-operate with the line player. Moreover, this game situation is also a key element of modern handball.

As Mavrikou (2015) reports, handball in Greece is not very well developed. As a result, players in the Greek Championship are not particularly qualitative. This has the consequence that these players will also fall short of the morphological characteristics. According to figures from the Hellenic Handball Federation (2018), the height of the central back players of the Handball Premier League is 182.9 cm, while the other back players (right and left) 190.5. cm. Overall, the height of all three back players has a mean of 186.7 cm. As mentioned by Krüger, Pilat, Ückert, Frech&Mooren (2014), from other high-level championships, the average height for back players is 193 cm . Ghobadi, Rajabi, Farzad, Bayati&Jeffreys (2013), report similar data with a value of height for back players 192.6. Therefore, a possible reason for the fact that the Greek back players choose the closest distance (between 6 - 9 meters) for their throws, is likely because of the lack of height. Yet another reason for throwing from this distance (6 - 9 meters) is the speed of the ball. The only data we have from Greek handball players for the speed of the ball are those of Zapartidis, Kororos, Christodoulidis, Skoufas&Bayios (2011), who examined handball players at the age of U18 and report 69.5 km / h for the center back player and 72 km / h for the other back players (left - right back). It is very easy to understand why Greek handball players choose throws from a moderate distance if we consider that in modern handball the speed of the ball reaches 139.3 km / h (Handball World, 2018).

In addition, the results show that most of the throws for all of the teams are headed to the low left side of the goal. These results are consistent with other research that suggests that most of the throws are directed at this point of the goal (Hianik, 2007; Oscar &Pascual, 2011). Still in terms of throwing efficiency, the highest value was 68.1% and was achieved from the right corner of the attack and from a distance between 6 - 9 meters. That is, from the position of the right wing. Of course, these throws were in total very few (22). If one considers the bigger number of the throws, then the effectiveness was 63.2% and was achieved from the central area of the attack and from a distance of 6-9 meters. That is, from the area where the center back player and the line player are most of the times. Highest throwing efficiency was found to be 64.6% from the left side of the attack and a distance of<6 meters. Especially in this area the left back player moves, making throws from 6-meter attempting breakthroughs and also the line player. The smallest efficacy was found in the left corner of the attack from a distance of> 9 meters with a very small number of throws (3). The highest value of the current study 64.6% appears to be consistent with results of other researchers such as Foretic et al. (2010), A Gomez et al. (2014), Ferrari, Dos Santos &Vaz (2014), and Leuciuc (2010), which reported an efficiency of 64.2%, 62.1%, 65.3% and 63.7% respectively.

Finally, with regard to the results of the x^2 test, it appeared that there were significant statistical differences with regard to the throwing distance and the effectiveness (goals) in the attack area from where these throws took place. Particularly in throws from a distance of <6 meters, the effectiveness of the left wing area varied considerably with the effectiveness of the center back player position. The center back player position area had significant statistical differences with the right side and also with the right corner area. Thus, the effectiveness of the area where the line player mainly plays differs significantly with the area where the wing players (left and right wings) are attempting and with the effectiveness of the throws from the right side of the attack where the line player and the right back attempts from the 6 meters.

From a distance of 6 to 9 meters the efficacy of the left side of the attack varied considerably with the central area, while the central area had significant statistical differences with the right side. So it seems that the center back player differs significantly in efficiency with the other 2 back players (left and right back) overcoming the other two. The center back player having the advantage due to the large angle of throw seems to differ significantly from the other two back players in terms of efficiency.

With regard to the distance > 9 meters, it seems that the areas of the attack that differ significantly in efficiency are the central area, the left side and the right side. Thus, the center back player differs significantly in efficiency with both the left back and the right back players. As with the distance of 6 - 9 meters, so in the throws made from 9 meters and further, the efficiency of the center back player differs significantly with the other 2 back players on both sides. From the above it can be seen that the large throw angle in the central area of the attack influences the effectiveness of the players and in particular of the back players. The total results from the x^2 test reveal inhomogeneity in the throwing efficiency from the attack areas and the players' positions with each other, at the same distance from which these throws are made.

5. Conclusions

In conclusion, we would say that the effectiveness of throws has many similarities to foreign values of teams and championships of another qualitative approach. What is important, however, is that Greek athletes try and make throws with an equivalent effectiveness between 6 and 9 meters, thus highlighting the lack of long distance throws (> 9 meters), a feature that characterizes modern handball. Finally, the effectiveness of throwing from the court areas and player positions between them, from the same distance, shows unevenness. There is a clear need for further research with a view to fully clarifying the specific indices in Greek handball.

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