Journal of Physical Education and Sport ® (JPES), Vol.20 (3), Art 187, pp. 1354 - 1361, 2020
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Stable and changing characteristics of high-level handball as evidenced from World Men's Championships

MELETAKOS G. PANAGIOTIS[1], NOUTSOS S. KONSTANTINOS[2], BAYIOS A. IOANNIS[3]
[1,2,3,]Sector of Sports Games, School of Physical Education & Sports Science, National & Kapodistrian University of Athens, GREECE

Published online: May 30, 2020
(Accepted for publication: May 18, 2020)
DOI:10.7752/jpes.2020.03187

Abstract:
The systematic observation and notational analysisof games helped the development of research in this particular field.The aim of the study is to present the model of play in high level Men's handball, taking a quantitative approach for the teams ranked in the first four positions, out of the total twenty four teams that participated in the eightconsecutive World Championships from 2005 to 2019, in order to seek differentiation over the years as well as highlight differences between the teams. The sample consisted of 300 matches, where all the relevant statistics for each team were recorded.Results showed that the total number of new offenses and shotsper game seem to have had a significant downward trend over the years, from 2005 to 2019, which however was not reflectedby a collateral drop in goals scored.Over the years, statistically significant fluctuations can be seen in the percentage distribution of goals for 6m, 9m and breakthroughs. In the last three championships, the number of goals scored for 6m equaled the ones scored for the 9m. No significant differences were observed over the years for the court players and goalkeeper efficacies, where the specific indices remain high and stable .The stepwise logistic regression model revealed that the court players' breakthrough efficacy, the goalkeeper's efficacy from 6m shots and the number of steals per game can discriminate the teams that won the first place from teams that ranked fourth. Decision making leaders must choose players who are able to support the strategies and tactics that the coach decides dependent on the circumstances and game development.
KeyWords: handball, toplevel, characteristics, differences

Introduction

The methodology employed in the notational analysis of sports has given an important advantage in analyzing and extracting knowledge of the structure and development of team sports. The advances in the sciences such as physiology, psychology, medical sciences and statistics that are related to the coaching process have as a result the multifaceted development of sports.

Ferrari et al. (2019) reported that the first organized systematic observation of games took place in the 1970 World Championship by a team of analysts that seem to have been the initiators of research at that level.Wagner et al. (2014) divides determinants according to team handball performance factors such as tactics, offense and defense and individual performance factors such as strength, endurance and coordination.Studies that followed focused on factors related to performance and success of the team, seeking key factor indicators and patterns that differentiate the winning teams from other teams and tendencies as well as the development from competition to competition over the years. Prieto et al.(2015) examined an important aspect of handball, the 2 min. exclusions, its effect on teams' scoring performance for teams that suffer the exclusion and for opponents.The time out calling in handball was the subject of the paper by Gomes et al. (2014) who concluded that its role is influenced by a multi-dimensional environment such as match location, match status and game period among others. Foretic et al.(2013) determined quantitatively the contribution of situational efficiency in top level handball which was supported by a software application they developed.In a study by Fasold and Redlich (2018),they examined fouls committed by a defense player and whether this influenced the goals scored. Debanne et al.(2018) examined the efficacy of penalties but taking a psychological approach.

Many researchers such as Roguli et al. (2004) used National League statistics to investigate the main elements of collective tactics in both score efficient and score inefficient teams in the First Croatian Handball League. Similarly Hatzimanouil et al. (2017) looked into the efficiency of shots per playing position relative to the efficiency of the goalkeeper during defense based on the Greek Premier League. Meletakos and Bayios (2010) analyzed the general trends related to total number of goals scored per match as well as percentage of closed games and home team wins in men's handball, sourcing their data from 7 European National Championships.

Corresponding Author: MELETAKOS G. PANAGIOTIS, E-mail: meletak@phed.uoa.gr

Studies have been carried out taking into consideration data from World, European Championships and Olympic Games. These studies, in general, considered more aspects such as total shots per game, goals scored per game, efficacy of court players and goalkeepers and goal score percentage from different positions. Rogulj (2000), Srhoj et al. (2001)and Gruic et al. (2006) utilized a number of performance indicators obtaining data from Men's World Championships, 1999 and 2003. Bilge (2012) used data from Olympic, World and European Men's Handball to determine factors that contribute to team success while Meletakos et al. (2011) looked into selected performance indicators through analysis of offensive parameters in three consecutive men's World Championships, 2005, 2007 and 2009. Gryko et al. (2018) with data from World Championships 2013 and 2015 looked into the efficiency of technical and tactical offensive and defensive actions.

Ferrari et al. (2018) conducted a study based on the offensive behavior and playing model of the French National handball team, which won the World Championship in 2015 in both junior and senior categories.Dumangane et al. (2009) using data from World Championships 2001-2005, analyzed direct and indirect means of dependence in the probability of scoring in a handball match where one team is influenced by the other.With a sample from Men's World Championships, Almeida et al. (2020), set about identifying the most relevant variables to characterize the performance level of the teams participating in seven consecutive competitions.A different approach is adopted by Meletakos et al. (2014), where the competitive balance in national championshipsserves as a mediatingeffect on the performance of the National team. The specific study relates to basketball and the performance of the national team was evaluated based on ranking in Eurobasket Championships. Similar research in handball does not currently exist.

The aim of the study is to present the model of play in high level men's handball, taking a quantitative approach of the first four teams of the World Championshipsfrom 2005 to 2019, to seek differentiation over the years as well as highlight differences between these first four World Championship teams.

Material & methods

The sample consisted of the 300 matches played in the last eight World Men's Handball Championships held inTunisia 2005 (40 games), Germany 2007 (40 games), Croatia 2009 (40 games), Sweden 2011 (32 games), Spain 2013 (36 games), Qatar2015 (36 games), France 2017 (36 games), Germany/Denmark 2019 (40 games).Twenty-four national teams participated in each competition.

Only the recorded performances of the teams placed in the first four positions in the final ranking were used in this study.

Thenationalteamsthatwere placed amongthe 32 positions, in the eight world championships were: France (7 participations- 4 first places, 2 third places and 1 fourth place),Denmark(5 participations - 1 first place, 2 second places, 1 thirdplaceand 1 fourth place), Spain (4 participations -2first places, 1 third place, 1fourth place),Croatia (4 participations -2 second places, 1 third place, 1fourth place), Poland(3participations - 1 second place, 2 third places), Germany (2 participations - 1 first place, 1fourth place), Norway(2 participations – 2second places)Slovenia (2 participations - 1third place, 1 fourth place), Qatar (1participation – 1second place), Sweden (1 participation - 1 fourth place), Tunisia(1 participation - 1 fourth place),see:Table 1

Table.1: Year of World handball Championship,hostcountry,matches played, and final ranking for first four positions

			Final Ranking			
Year	Host Country	Maches per team	1st	2nd	3rd	4th
2019	Germany/Denmark	10	Denmark	Norway	France	Germany
2017	France	9	France	Norway	Slovenia	Croatia
2015	Qatar	9	France	Qatar	Poland	Spain
2013	Spain	9	Spain	Denmark	Croatia	Slovenia
2011	Sweden	8	France	Denmark	Spain	Sweden
2009	Croatia	10	France	Croatia	Poland	Denmark
2007	Germany	10	Germany	Poland	Denmark	France
2005	Tunisia	10	Spain	Croatia	France	Tunisia

The variables that were studied were obtained from the official statistics of the International Handball Federation (IHF). In every World Handball Championship a group of specialized personnel use standard procedures to record every match. Thus,the present dataarethe officially recorded statistics.

The variables that were analyzed were: 1-Shots per game, 2-Goals per game, 3-Goal percentage distribution 4-Court player efficacy 5-Goalkeeper efficacy. These variables were analyzed in total and specifically. According to the discrimination that was proposed by Meletakos et al.,(2011), some variables reflect position, in other words a spatial area of the court, which are the 6m, wing and 9m, while others reflect a situation of play, the 7m (penalty), fast break and breakthrough.

The full description of these variables is as follows:1. Six-meter: (shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution%) from the line player, from a zone outside the 45^0 angle from the left and right; 2. Wing:(shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution%) from within an angle of 45^0 left and right without a defense player in front; 3. Nine-meter: (shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution%) from a backcourt player either (a) over or through the defense, and (b) after a breakthrough but with another defense player in front; 4. Penalty: (shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution %) from the seven-meter line (penalty) without a record of where the actual transgression was committed; 5. Fast break: (shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution %) in fast breaks (until defense is organized); 6. Breakthrough:(shots attempted, goals scored, court player efficacies, goalkeeper efficacies, goal percentage distribution %) (a) by the backcourt players after breakthrough in the 9 m zone without a defense player in front, (b) by the pivot after 1:1 situation, (c) by the left or right wing after breaking through 1:1 situations).Finally, the variables related to the positive and negative actions were technical fouls per game, steals per game, blocks per game and 2min. suspensions.

Statistical analysis

All variables were described with their mean and standard deviation and were compared between championships with the ANOVA procedure. Correlation coefficients were also employed. For the purpose of determining which variables were more instrumental in discriminating teams ranked first or fourth, a forward logistic regression model was performed. The level of significance was set at 0.05.

Results

The basic descriptive statistics that involve shots per game, goals per game and goal percentage distribution can be seen in Table 2.

Table 2. Mean and standard deviation of shots and goals per game and goal percentage distribution over all the eight world championships for teams placed 1-4 (n=32).

	Shots per game		Goals per game		Goals percentage distribution (%)	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
6m	8,8	2,6	6,0	1,7	20,1	5,7
Wing	6,6	1,6	4,2	1,2	13,8	3,8
9m	18,4	3,5	8,2	1,7	27,2	5,3
7m	3,7	0,8	2,8	0,7	9,6	2,4
Fast break	7,0	1,5	5,5	1,1	18,3	3,5
Break through	4,1	1,6	3,2	1,2	10,8	4,1
Total	48,8	3,0	30,1	1,9	100	

Table 3 contains the descriptive statistics for the efficacy of court players and goalkeepers.

Table 3. Mean and standard deviation of court player efficacy and goalkeeper efficacy over all the eight world championships for teams placed 1-4 (n=32). Values are shown in percentages (%).

	Court Player Efficacy		Goal Keeper Efficacy	
	Mean	Std. dev	Mean	Std. dev
6m	69,0	6,3	27,2	6,8
Wing	62,9	8,2	36,8	8,6
9m	44,7	5,1	46,4	5,4
7m	77,4	7,7	22,1	7,0
Fast break	79,7	5,0	18,9	7,8
Break through	79,2	8,8	20,2	10,0
Total	61,9	3,2	33,6	3,0

In Table 4 we can see positive and negative actions of offense and defense and the two-minute suspension, the discipline control of the game.

Table 4. Mean and standard deviation of assists, technical fouls, steals, blocks and 2min. suspensions per game over all the eight world championships for teams placed 1-4 (n=32).

	Mean	Std. Deviation
Assists	14,0	3,0
Technical Faults	10,9	1,7
Steals	5,4	3,6
Blocks	3,4	1,0
2 min Suspensions	3,6	0,7

As table 5 shows, there was a significant decrease of the mean number of total shots per game from 2005 to 2019 (ANOVA test, F(7)=7.2, p<0.001). At the same time, the mean number of goals per game remained roughly the same (F(7)=1.6, p=0.195). As a result, there was a rise in the mean total efficacy (F(7)=2.0, p=0.098), which however did not achieve statistical significance. With reference to goalkeeper efficacy, there seems to be a decreasing trend that however was not found to be statistically significant (F(7)=2.3, p=0.063).

Table 5. Mean and standard deviation oftotal shots and goals per game and total efficacy court player (Cp) and goalkeeper (Gk) for each of the eight championships.

	Total Shots		Total Goals		TotalEfficacy (Cp, %)		TotalEfficacy (Gk, %)	
W. Ch	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
2005	52,1	1,5	32,0	2,3	61,5	3,8	34,2	1,7
2007	52,5	1,3	30,7	0,7	58,5	1,0	35,2	0,9
2009	48,6	1,5	29,7	0,1	61,2	1,7	36,0	1,6
2011	48,8	1,7	30,7	2,6	63,0	4,9	29,7	4,3
2013	49,4	3,1	30,4	1,6	61,5	1,2	35,5	0,5
2015	45,9	1,0	28,0	1,2	61,0	2,4	33,2	3,7
2017	47,6	1,4	30,0	1,3	63,0	3,1	32,2	3,8
2019	45,1	2,7	29,7	2,7	65,7	2,8	33,0	2,1
ANOVA	F(7)=7.2 p=0.001		F(7)=1.6 p=0.195		F(7)=2.0 P=0.098		F(7)=2.3 P=0.063	

As expected, there was a significant correlation between the shots per game and the goals per game (r=0.651, p<0.01)

Technically, a team gains a chance to attack whenever the opponent either had an unsuccessful shot or made a technical foul:New offenses per game = (Shots per game-Goals per game)+Technical faults per game

Table 6 shows the differences in unsuccessful shots, technical faults and new offenses per game from 2005 to 2019. The ANOVA test showed statistically significant reduction both of unsuccessful shots and technical fouls, which resulted in a much more significant reduction of the number of new offenses.

Table 6. Mean and standard deviation of unsuccessful shots, technical faults and new offenses per game for each of the eight championships.

W.Ch	Unsuccessful shots per game		Technicalfaults per game		Newoffenses	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
2005	20,1	2,1	11,6	0,3	31,7	1,8
2007	21,8	0,9	11,2	0,7	33,0	1,0
2009	18,9	1,4	12,3	1,5	31,2	2,3
2011	18,1	2,4	11,4	2,1	29,5	2,3
2013	19,0	1,7	10,9	1,2	29,9	0,6
2015	17,9	1,2	12,0	1,3	29,9	1,8
2017	17,6	1,8	9,9	0,8	27,5	1,1
2019	15,4	1,1	8,0	1,7	23,4	2,3
ANOVA	F(7)=5.1 p=0.001		F(7)=4.5 p=0.002		F(7)=10.9 p<0.001	

In Table 7 we can see the percentage goal distribution from 6m, wing and 9m that imply the space on the court from where the goal was scored, and the 7m (penalty), fast break and breakthroughs that imply a situation

Table.7: Goal percentage distribution per position and situation for each of the eight championships.

W.Ch	6m	Wing	9m	7m	Fast Break	Breakthroughs
2005	20,5	12,2	25,0	11,7	19,6	10,7
2007	20,3	10,8	35,3	7,5	17,7	8,0
2009	18,6	16,0	29,9	9,4	18,3	7,5
2011	13,7	15,5	29,6	9,4	17,7	13,7
2013	13,2	15,3	24,3	10,1	21,9	14,9
2015	25,3	10,2	25,1	11,2	15,5	12,4
2017	26,1	15,0	23,5	8,1	19,8	7,2
2019	22,8	15,4	24,7	9,1	16,0	11,7
ANOVA	F(7)=6.0 p=0.001	F(7)=1.7 p=0.165	F(7)=3.7 p=0.008	F(7)=1.4 p=0.246	F(7)=1.6 p=0.186	F(7)=2.8 p=0.028

The ANOVA test gave statistically significant differences from the 6m (F(7)=6.0 p=0.001) and 9m (F(7)=3.7 p=0.008) as well as for the breakthroughs (F(7)=2.8 p=0.028) where fluctuations were observed.

Initially a reduction was observed, followed by a significant increase in goal percentage from the 6m position.On the contrary, the goal percentagefrom the 9m position evidenced a significant reduction (see Figure 1). The paired t-test showed that in Championships between 2007-2013, the differences in goal percentage from the 6m and 9m were statistically significant, the highest percentage of goals coming from the 9m position. But in the last three World Championships (2015-2019),the differences in percentage of goals from the 6m and 9m positions were not statistically significant.

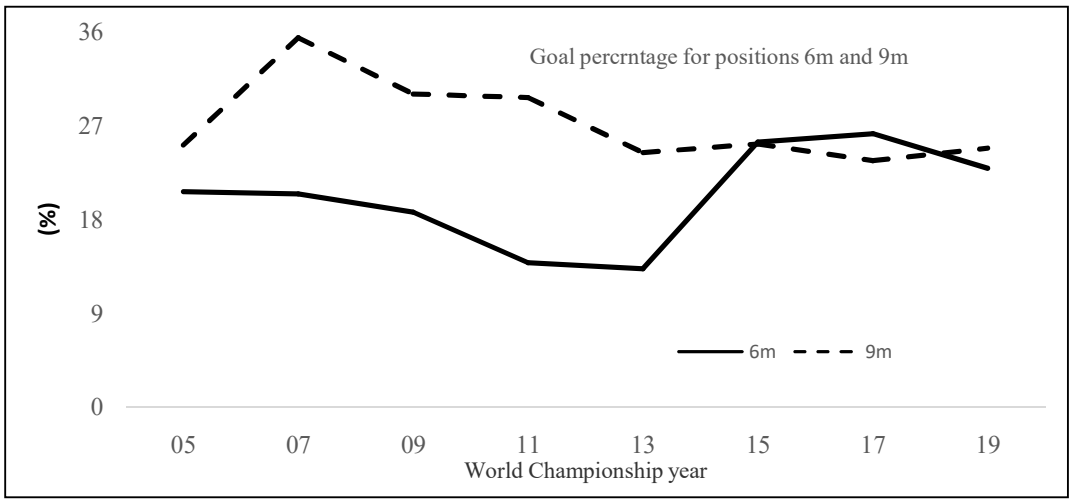

Figure 1: Goal percentage distribution for 6m and 9m positions in eight consecutive World Championships

In Tables 8 and 9 we can see court player and goalkeeper efficacies for different positions and gamesituations from 2005 to 2019. Statistically significant differences were observed only for the 6m position(F(7)=2.6 p=0.037).

Table. 8: Court player efficacies (%)

	Court Player Efficacy					
W.Ch	6m	Wing	9m	7m	Fast Break	Breakthroughs
2005	63,0	57,7	44,2	77,2	81,2	79,5
2007	70,0	59,0	44,5	71,2	77,7	78,2
2009	68,5	61,5	45,7	80,2	77,2	87,5
2011	77,5	59,7	47,5	79,7	76,7	76,2
2013	69,7	60,7	42,7	83,7	79,0	70,5
2015	70,2	66,2	38,7	75,7	81,7	83,0
2017	64,0	72,2	45,2	70,0	83,0	80,7
2019	68,7	66,5	49,2	81,5	81,2	78,0
ANOVA	F(7)=2.6 p=0.037	F(7)=1.6 p=0.184	F(7)=1.8 p=0.138	F(7)=1.9 p=0.112	F(7)=0.9 p=0.557	F(7)=1.4 p=0.264

Table. 9: Goalkeeper efficacies (%)

Goalkeeper Efficacy						
W.Ch	6m	Wing	9m	7m	Fast Break	Breakthroughs
2005	32,2	42,7	46,0	21,2	19,2	16,2
2007	25,0	44,5	46,0	23,2	23,0	22,2
2009	27,0	42,0	47,2	23,5	17,5	9,7
2011	22,5	34,5	38,5	15,0	23,7	25,5
2013	22,0	38,2	50,0	25,0	20,5	24,5
2015	31,5	31,2	49,7	28,0	20,0	16,0
2017	27,5	31,7	48,2	21,5	12,0	25,2
2019	30,2	30,0	46,0	20,0	15,2	22,2
ANOVA	F(7)=1.5 p=0.226	F(7)=2.3 p=0.064	F(7)=2.2 p=0.070	F(7)=1.2 p=0.323	F(7)=1.0 p=0.466	F(7)=1.4 p=0.268

Finally, the stepwise logistic regression model showed that three variables, namely the court players' breakthrough efficacy, the goalkeeper's efficacy from 6m shots and the number of steals per game, can discriminate the team that won the first place from teams that ranked fourth ($p<0.05$).

Specifically (Figure 2) 6 outof eight teams (75.0%) that ranked first in the championships achieved a breakthrough efficacy of more than 80%. On the contrary only one out of eight teams (12.5%) that ranked fourth had a breakthrough efficacy of more than 80% (Fisher exact test, $p<0.05$). Likewise, 5 from the eight teams (62.5%) that ranked first in the championships achieved a goalkeeper 6m efficacy of more than 32%. On the contrary only one out of eight teams (12.5%) that ranked fourth had a goalkeeper 6m efficacy of more than 32% (Fisher exact test, $p<0.05$).

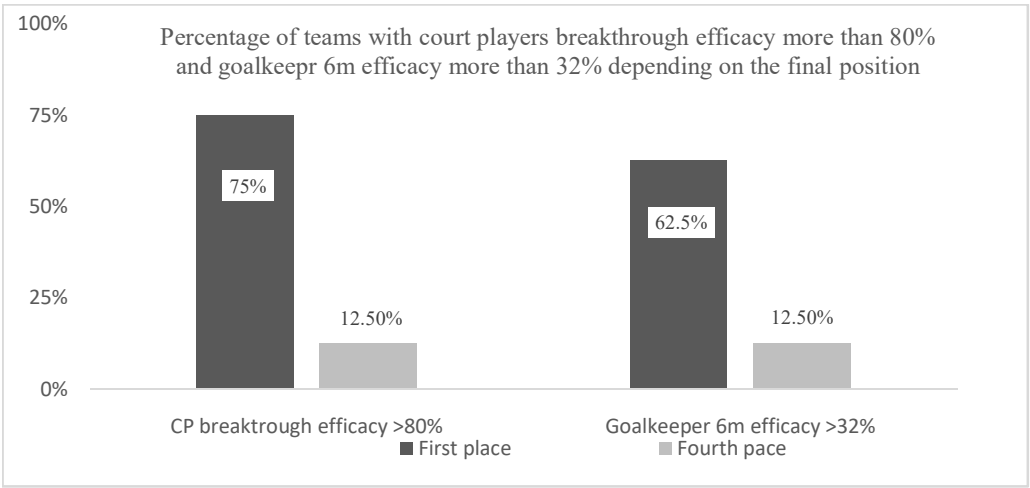

Figure 2: Discriminate the team that won the first place from teams that ranked fourth.

Discussion

In team sports, the final outcome is dependent on and influenced by many factors; Technical and tactical levels, somatometric indices (Rousanoglou, Noutsos, & Bayios, 2014; Giannopoulos, Vagenas, Noutsos, Barzouka, & Bergeles, 2017; Noutsos, Meletakos,& Bayios, 2019), the experience of the athlete (Noutsos, Rousanoglou, Meletakos, Bayios, & Boudolos, 2018),and specific physical conditioning (Cardinale, Whiteley, Hosny, & Popovic, 2016) among others.

The present study aimed to show the characteristics of the four top ranking teams within a time period of 14 years that included the last eight World Championships. This way, we wanted to depict the way the teams compete as recorded in the statistical game data and highlight probable longitudinal changes. Moreover, we wanted to seek out key factor indicators that significantly influence the discrimination between the teams ranked first and fourth in the championships.

For our study, we used the shots per game, goals per game, goal percentage distribution, court player efficacy, goalkeeper efficacy both total and from different positions (6m,wing and 9m) and different situations (7m penalties, fast break, breakthrough). In addition, we evaluated actions related to offense (assists and technical fouls), defense (steals and blocks) as well as two-minute suspensions that are included in the discipline control of the game.

With reference to the distribution of the goal percentage from different positions and situations, our results agree with similar research (Bilge, 2012) that involvedthe top eight ranked teams in twoOlympics three World Champions and four European Championships from 2004 to 2010. It seems that the top teams follow the same pattern as far as choosing the same positions and game actions to score. Our research took into consideration the four top teams and the above research was based on the top eight teams. If the sample included teams from the middle down ranking, the results would possibly have been different.

The efficacy of court players and goalkeepers has an inversely proportional relation. For court players, the highest efficacies are in fast breaks, breakthroughs and 7m (penalties) while in positions, the highest efficacies can be seen at the 6m, followed by the wing and 9m.An inverse pattern can be seen for goalkeeper efficacies, the lowest being fast breaks, breakthrough and 7m and the highest for 6m, wing and 9m.

The efficacies of court players and goalkeepers are directly related to the success of the team.The total court player efficacy in our study approaches 62% without there being statistically significant differences in the eight World Championships and the efficacy ranged from 58.5% to 65.7%. As for the total goalkeeper efficacy, the mean value was at 33.6% without observing statistically significant differences, the range being 29.7% to 37.6%. In the study by Skarbalius (2013) that was based on game related statistics, the discrimination between winning and losing teams in Men's European Handball Championships (2002-2010) shows total shot efficacies

for the winning teams that range from 58.3% to 60.3% while the respective goalkeepers had efficacies between 33.6% and 37.3%, suggesting that the efficacies of total and long distance shots might be used as key indicator indices that differentiate the top teams.

The number of shots attempted is directly related to the number of goals scored. In our study, the total shots per game seem to have had a pronounced downward trend over the years, from 2005 to 2019. This drop in total shots did not reflect a drop in goals scored that perhaps one would have expected. Our results of the total shots per game and the resulting unchanged number of goals per game tally with those of Meletakos et al.(2011) that included all the 24 teams that participated in the three World Championships in 2005, 2007and 2009.

It would seem that teams have become more "mindful" of their attempted shots. This would further imply that there is a lot more practice and technical-tactical preparation and players with a high level of mental game skills. The fact that there are fewer attempted shots but the same number of goals scored means that the opponent has a fewer number of new offenses (and thus fewer possibilities of scoring) and this is very crucial for the final result.

It is noteworthy that the results of our study show that there are no statistically significant differences both in total efficacies of court players and goalkeepers, despite the fluctuations. Meletakos et al. (2011) showed (ina sample including all 24 teams) that the total efficacy of the court players were not statistically significant between the championships, the mean being 54.2% while in our study the mean is again not statistically significant, 61.9% (2005-2019) which is deemed logical as we are considering only the top four teams.

It seems that the court player and goalkeeper efficacies are two indicesthat have reached a plateau, which must be undeniably high to achieve top positions.

Based on the logic of how many times the opponent is able to be on the offense, we calculated the new offenses index. According to the results of our study, there is a statistically significant drop in new offenses between 2005 and 2019, which supports our view of a technical and tactical level of players and mental abilities that allow them to make the optimum decision during a continuously varying game play environment. The new offenses per game reached their lowest level during the last 2019 World Championship that, in our opinion, is a qualitative aspect of the development of the players.

The position from where or situation in which a team chooses to attempt a shot is of pivotally strategic importance. This decision is related to special team characteristics, evidently the existence of a high-level player at a certain position, promoting actions to be taken from this position and conversely the weak spots of the opposing team will guide the play to take action at this position.There is a clear "dialectical relationship" between offense and defense and it always has to be taken into account when drawing final conclusions.

Our results showed that over the years statistically significant differences can be seen in the percentage of goal distribution for 6m, 9m and breakthroughs. In the last three World Championships (2015,2017,2019) there is an obvious increase in the percentage of goals scored from the 6m, which equals the percentage of goals scored from the 9m position. Therefore, for the first five World Championships (2005-2013), the mean goal percentage from the 9m position was 11.5% more than the 6m position, but this difference was completely annulledin the last three championships. Undoubtedlythis finding reflects the way the top teams develop their play. This way of play is preferred, as most coaches would prefer a shot attempt from the 6m position where effectiveness is at 69% rather than one at the 9m position where effectiveness is at 44.7% according to our results.It must also be taken into account that high-level shooting skills of backcourt players probably provokes guarding by defense players quite a distance away from the 6m line even with 6-0 defense system, together with two or three level defense zone (5:1, 3:2:1) that creates a situation with more space to receive the ball and a shot by the line player.

It is very important for back court players to be very skillful in passing the ball to the line player, who, besides the pivot, many times can be the wing player who cuts through to the 6m position, acting like a second pivot. However, to be able to perform an assist pass to the line player, there must definitely be players with excellent throwing abilities that will galvanize and stimulate the defense against him and thus create the opportunity for an assist pass to the line player. In addition, due to the increase of percentage goals from the 6m position, one would expect an increase in the number of assists. However, this is not supported by our results as there are no statistically significant differences in assists over the years.

Finally, our findings revealed that, even among the top four teams, teams that won the first place can be discriminated from teams that ranked fourth by a set of key factors, namely the court players' breakthrough efficacy, the goalkeeper's efficacy from 6m shots and the number of steals per game.

Conclusion

The present findings reveal that the top-ranking teams in men's handball seem to have reached a plateau withregards to the court players and goalkeeper efficacies, leading the teams to change their tactics towards more mindful attacks giving a preference to 6m shots and minimizing the opponents' chances of new offenses.

References

Almeida, A.G., Merlin, M., Pinto, A., Torres, R.S., Cunha, S. A. (2020).Performance-level indicators of male elite handball teams. *International Journal ofPerformance Analysis in Sport,* vol.20. nr.1, 1-9.

Bilge, M. (2012). Game Analysis of Olympic, World and European Championships in Men's Handball.*J Hum Kinet,* 35, 109-118.

Cardinale M., Whiteley R., Hosny A. A., Popovic N. (2016). Activity Profiles and Positional Differences of Handball Players During the World Championships in Qatar 2015. *Int J Sports Physiol Perform*. 2016: 1-23.

Debanne, T., Laffaye G., Trouilloud, D. (2018).Motivational orientations and performance in penalty throws during elite male team handball games.*Scandinavian Journal of Medicine and Science in Sports,* 28(3) DOI: 10.1111/sms.12995.

Dumangane,M., Rosati, N., Volossovitch, A. (2009).Departure from independence and stationarity in a handball match.*Journal of Applied Statistics.* Vol.36, - Issue 7, pg. 723-741.

Fasold, F., Redlich, D. (2018). Foul or no Foul? Effects of Permitted Foulson the Defense Performance in Team Handball.*Journal of Human Kinetics* vol. 63, 53-59. DOI: 10.2478/hukin-2018-0006.

Ferrari, W., Vaz, V., Sousa, T., Couceiro, M., & Dias, G. (2018). Comparative Analysis of the Performance of the Winning Teams of the Handball World Championship: Senior and Junior Levels. *International Journal of Sports Science*, 8(2), 43-49. doi: 10.5923/j.sports.20180802.01.

Ferrari, W.R., Sarmento, H., Vaz, V. (2019).Match Analysis in Handball: A Systematic Review. Monten. J. *Sports Sci. Med. 2019, 8(2), 63-76* | DOI: 10.26773/mjssm.190909.

Foretić, N., Rogulj, N., Papić, V. (2013). Empirical model for evaluating situational efficiency intop level handball. *International Journal ofPerformance Analysis in Sport*, 13, 275-293.

Giannopoulos N, Vagenas G, Noutsos K, Barzouka K, Bergeles N. (2017).Somatotype, level of competition, and performance in attack in elite male volleyball.*J Hum Kinet,* 58: 131–140, 2017.

Gomes, F., Volossovitch, Anna, Ferreira, A.P. (2014).Team timeout calling in handball. *International Journal of Performance Analysis in Sport,* 14, 98-110.

Gruic, I., Vuleta, D., Milanovic, D. (2006). Performance indicators of teams at the 2003 men's World Championship in Portugal. *Kinesiology*, 38, 2:164-175.

Gryko, K., Bodanski, S., Bodasinska, A., Zielinski, J.(2018). Offensive and defensive play in handball in a 2-year world championship cycle: Characteristics and tendencies, *Pol. J. Sport Tourism*, 25, 10-16 DOI: 10.2478/pjst-2018-0014

Hatzimanouil, D., Giatsis, G.,Kepesidou, M., Kanioglou, A., Loizos, N. (2017). Shot effectiveness by playing position with regard to goalkeeper's efficiency in team handball. *Journal of Physical Education and Sport*, 17(2), 656.

Meletakos, P., Bayios, I. (2010). General trends in European men's handball: a longitudinal study.*International Journal ofPerformance Analysis in Sport,* 10(3), 221-228.

Meletakos, P., Vagenas, G., Bayios, I. (2011). A multivariate assessment of offensive performance indicators in Men's Handball: Trends and differences in the World Championships. *International Journal of Performance Analysis in Sport*, 11(2), 284-294.

Meletakos, P., Noutsos, K., Manasis, V., Bayios, I. (2014). The mediating effect of competitive balance on the relation between foreign players and performance of Greek national basketball team. *Journal of Physical Education and Sport Management,* vol. 5 (7), 72-80.

Noutsos, K., Rousanoglou, E., Meletakos, P., Bayios, I., Boudolos, K. (2018). Performance indicators and competition ranking in women's and men's world handball championship 2017.*Journal of Physical Education and Sport*, 18(3), 1761– 1766.

Noutsos, K.,Meletakos, P., Bayios, I.(2019).Morphological characteristics of adolescent elite female handball and volleyball players. *Journal of Physical Education and Sport* 19, 1502-1507.

Rousanoglou, E., Noutsos, K., Bayios, I.(2014). Playing level and playing position differences of anthropometric and physical fitness characteristics in elite junior handball players. *Journal of Sports Medicine and Physical Fitness*, 54(5), 611–621.

Prieto, J., Ruano Gomez, M.A., Sampaio, J. (2015). Players' exclusions effects on elite handball teams' scoringperformance during close games.*International Journal of Performance Analysis in Sport,* 15(3):983-996.

Rogulj, N. (2000). Differences in situation-related indicators of the handball game in relation to the achieved competitive results of teams at 1999 World Championship in Egypt. *Kinesiology*, 32 (2), 63-74

Rogulj, N.,Srhoj, V., Srhoj, L. (2004). The Contribution of Collective AttackTactics in Differentiating HandballScoreEfficiency.*Coll.Antropol*. 28 (2): 739–746.

Skarbalius, A., Pukenas, K., Vidunaite, G. (2013).Sport performance profile in men's European modern handball: Discriminant analysis between winners and losers. *Baltic Journal of sport and health sciences*, vol.3, nr. 90.

Srhoj,V., Rogulj, N., Katic, R. (2001). Influence of the Attack end Conduction on match Resultin Handball. *Coll. Antropol.* 25, 2: 611–617.

Wagner, H., Finkenzeller, Würth, S., Duvillard, S.P. (2014).Individual and Team Performance in Team-Handball: A Review. *JournalofSportsScienceandMedicine*, 13, 808-816