

A Study on the Competition of the World Women's Handball Championship Using Bigdata : Focused on the top 5 teams of the 2007-2019 World Women's Handball Championship

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빅데이터를 활용한 여자핸드볼선수권대회 전력 비교 연구 -2007~2019년 세계여자핸드볼선수권대회 상위 5개팀과 대한민국을 중심으로-

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Abstract This study was conducted seven times from 2007 to the 2019 Women's World Handball Championships to analyze and strengthen the strength of the Korean women's handball team through the analysis of the top five countries' strengths. Among the 41 national teams participating in the World Women's Handball Championship, a total of five national teams, including the Netherlands, Norway, Russia, Spain, and France, were selected for the final study. Among the records provided by the International Handball Federation (IHF), the ranking was selected by analyzing the competition records of 41 participating countries, and technical statistics and frequency analysis were conducted using the SPSS/PC+ Ver21.0 program. based on the accumulated records of the top five women's handball competitions, handball attack and defense strategies that can make up for the inferiority in future physical conditions are needed and detailed follow-up studies are needed. Also, we hope to use it as a basic resource for improving the performance of Korean women's handball players and to play a key role in enhancing the level of women's handball at the 2021 Tokyo Olympics.

Key Words : World Women's Handball Championship, Scoring route, Success rate by shooting type, Assist, Steal, Block frequency, Tokyo Olympic games, Handball strategies

요 약 본 연구는 2007년부터 2년마다 열리는 세계대회를 7회에 걸쳐 2019년 세계여자핸드볼선수권대회까지 상위 5개 국가의 전력을 분석하고 대한민국과 비교를 통해 대한민국 여자핸드볼팀의 전력분석 및 강화를 위하여 진행하였다. 연구의 대상은 세계여자핸드볼선수권에 참가한 41개 국가 팀 중, 3회 이상 4강(4위)에 성적을 거둔 5개 국가, 네덜란드, 노르웨이, 러시아, 스페인, 그리고 프랑스까지 총 5개 국가 팀을 최종 연구대상으로 선정하였다. 자료는 국제핸드볼연맹(IHF)에서 제공하는 기록 중 총 참가국 41개국의 경기기록을 분석하여 순위를 선정하였으며, SPSS/PC+ Ver21.0 프로그램을 이용하여 기술통계 및 빈도분석을 실시하였다. 세계여자핸드볼 상위 5개 팀 대회 기록을 바탕으로 볼 때 차후 신체조건에 대한 열세를 만회할 수 있는 핸드볼 공격 및 수비 전략이 필요하고 이에 대한 세부적인 후속연구가 필요할 것으로 사료된다. 또한, 대한민국 여자핸드볼선수들의 경기력 향상의 기초자료로 활용하고 향후 2021년 도쿄올림픽의 여자핸드볼 경기에서 보다 높은 경기수준을 높일 수 있는 단초 역할을 기대한다.

키워드 : 세계여자핸드볼선수권대회, 득점경로, 슈팅유형별 성공률, 어시스트, 스틸, 블록, 도쿄올림픽, 핸드볼 전력분석

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1. Introduction

1.1 Background of Conducting the Study

The 'game (or match) analysis' is a widely used method to determine players' both individual and general performance, teams' general condition during the game, and further evaluate and even understand competitors' tactics and performing skills [1]. Analysis is a crucial component of general evaluation and periodic assessment which could be the basis of forming the training program [2]. Performance measurement and assessment is now being nominated as one of the main subjects of workouts and training science.

Performance assessment and measurement is considered as a crucial factor that should be utilized to plan training processes and further competition [3]. Post-match analysis is necessary to evaluate the team's performance in each game, and the bulk analysis after a particular season, tournament or championship becomes an important scale to determine the team's success or failure, and even gives a guideline to the overall evaluation of the team itself [4]. Today's computing technology has helped the era of big data to be started. Big data represents the possibility of providing enormous information and datum which are consistently updated, to organizations and teams [5]. In sports, big data provides an opportunity to understand athletes' technical, tactical, and physiological behaviors.

Monitoring and registering the skills and tactics which occurs during various handball competitions and matches helps to bring out several objective indicators which are deeply related to the actual capacity of a particular male or female athlete as well as the overall handball team might be presented. When delving into previous studies which mainly dealt with sports using big data, there are various studies

applying big data in sports such as 'The impact of average temperature on the performance of batters in baseball' [6], 'Taekwondo competitive strategy' [7], and 'tennis game analysis' [8]. However, the investigation and study related to 'handball' applying various big data related theories was unfortunately still insufficient.

2010 World Junior Handball Competition [9], 2008 Beijing Olympics Men's Handball Competition [10,11], Handball Korea League [12], 2015 World Women's Handball Championship [13], and 2016 Summer Olympics Korea Women's Handball [14] are the most mentioned handball games when reviewing the previous studies which mainly dealt with the history of tactics used in Domestic and International Handball Competitions. However, still we can rarely find the studies and papers which mainly targeted the strategy analysis based on the data of Korean handball players and accumulated datum of International Woman Handball Competitions. Therefore, there is a high need for studies which diversely deals with the game records of Korean female handball team, to ultimately support the female handball players in Korea to achieve a medal from international and domestic competitions.

In 2002, when Korea-Japan World Cup was being held in Korea, the concept of 'sports analysis' was kept being a certainly unfamiliar one - until Guus Hiddink introduced the concept in earnest and let it be widely spread and applied in Korea. Nowadays it is being conducted and applied in almost every field of sports. Video analysis, which now is a very familiar and common method of analysis, was at that time a very hot, new, and unfamiliar topic. When all sports fans were watching the 2002 Korea-Japan World Cup, the Oakland Athletics, one of the poorest clubs without a star player, created an event that would be recorded as a legend in the 140-year history of the U.S.

professional baseball league. 'Billy Beane', who was the owner of the club at that time, practically utilized the data and statistical analysis system, and was to release all the high-paying players from the team and hired new players which had good on-base percentage but had relatively lower annual salary. This decision made him become an object of ridicule, but surprisingly his 'Money ball strategy' based on low cost, high efficiency method succeeded and brought 20 wins in a row from August 13, 2002 to September 4th. As such, sports analysis was introduced to Korea about 20 years ago and now being consistently spreading, but it is still difficult for sports analysis to be the main element which can bring a team's improvement and victory. This sports analysis seems to have been relatively limited to popular sports, making it even more difficult to shine in unpopular sports such as handball.

Korean handball team has won a total of seven medals (two gold, four silver, one bronze) in the whole previous Olympics, and this shows that handball had an overwhelmingly good results from Olympics over other group sports. However, at the 2016 Rio Olympics, women's handball was eliminated from the group stage for the first time ever, and received the worst report card ever, ranking 10th out of 12 countries. By applying the data analysis to the four games excluding the one with Argentina- which is the weakest in the same group-, we were able to know that from 10 minutes in the second half, the team scored an average of 6 points in offense and 8 goals in defense.

As a result, the biggest problem that was found by the data analysis was that there were more lost points than the scored points. Therefore, the purpose of this study is to present the offense strategies to the Korean female handball players, by analyzing the major scoring paths, shooting success rates and

reviewing the actual games played with the top five handball teams Dutch, Norway, Russia, Spain, and France.

2. Research Method

2.1 Investigation Method

Based on the results of the World Women's Handball Championship, which is held in every two years, the first target of this study was chosen as 23 national teams that participated in more than 4 times (57%) from 41 national teams participating in the World Women's Handball Championships from 2007 to 2019. After choosing the first targets, 11 teams were decided as the second targets - which were 11 national teams which at least once played game in the quarterfinals (4th place) out of 23 national teams that have participated more than four times. From the second targets, finally, a total of five teams, including Norway, France, Spain, Russia, and the Netherlands, were selected for the final research.

The results of deciding to use the data from 2007 was because the IHF did not provide sufficient handwriting and data, so that the data which could be used for the study was insufficient. Plus, the reason of selecting the top five 'countries' was because in this study it was better to focus on 'international' championships such as the World Championships and Olympic Games and further the results of European Championships were also included.

2.2 Investigation tools

This study was intended to be further used as the basic data for strength and strategy planning -by analyzing the game managing strategies and results of the top five female handball teams which participated in the 2007-2019 World Women's Handball Championships. The top five teams were Dutch, Norway, Russia, Spain, and France- and this study mainly focused on the

game results between the five teams and South Korea. The data were prepared by analyzing the competition records of 41 participating countries among the records provided by the International Handball Federation (IHF). Major analysis variables were used as main variables for the physical conditions (height, weight, age), field shots, positional attack. Further considering the variables, game performing capacity and distance was also additionally analyzed. The competition records and analysis variables were described in Table 1 and Table 2.

Table 1. Match Records

Teams	Matches	%
Netherland(NED)	10	17.24
Spain(ESP)	10	17.24
Russia(RUS)	10	17.24
Norway(NOR)	10	17.24
France(FRA)	9	15.52
Korea(KOR)	9	15.52
Total	58	100

Table 2. Analysis Variable

Fields	Shots					
	6m	Wing	9m	7m	Fast Breaks (FB)	Breakthroughs (BT)
	Assists (AS)	Steals (ST)	Turnover (TO)	Blocked shots (BS)	Goals Efficiency(%)	

2.3. Data analysis

Based on the 2007-2019 World Women's Handball Championship competition records provided by the International Handball Federation, the top five teams were decided. The top five teams and South Korea's major metrics - key scoring paths, success rate by shooting type, by type of shooting- was mainly used. The data were presented with descriptive statistics and frequency analysis using the SPSS/PC+ Ver21.0 program.

3. Research Results

3.1 Comparison of top 5 teams and physical condition in Korea

Table 3 shows the average physical condition of the female handball players of South Korea and the players from Top 5 teams of 2007-2019 International Female Handball Championship. In the case of height, Russia, Norway, the Netherlands, France, and Spain were followed, and in the case of South Korea, they were 1.8cm smaller than Spain, the smallest of the top five teams. The average weight was ranked as Netherlands, Russia, Spain, and France, while South Korea recorded the lowest weight at 65.7 kg. Spain had the highest average age, while the Netherlands had the lowest age at 24.7. Based on the world handball record, South Korea is inferior in height and weight when compared to the top five teams.

Table 3. Comparison of the World's Top 5 Women's Handball Teams and Korea's Average Physical Conditions(2007~2019)

Teams	Height (cm)		Weight (kg)		Age (yr)	
NED	176.0	0.3	70.2	1.4	24.7	-1.3
NOR	176.3	0.6	-	-	26.8	0.8
RUS	179.3	3.6	70.0	1.2	25.7	-0.3
ESP	174.4	-1.3	69.7	0.9	27.6	1.7
FRN	175.6	-0.1	68.3	-0.5	25.9	0.0
KOR	172.6	-3.1	65.7	-3.1	25.1	-0.9
Ave.	175.7		68.8		26.0	

3.2 Comparison of field shots between the top five teams and South Korea

When comparing the field shoots of Korean female handball players and the ones from the top five women's handball teams from 2007 to 2019, the result data was shown as Table 4, Table 5 and Table 6.

Table 4. Comparison of Field Shooting Success Rate with Top 5 World Women's Handball Teams(Total, 6m)

Teams	M	Total			6m		
		Goals	shots	%	Goals	Shots	%
NED	8	247.2	418.2	59	62.2	90.2	69
NOR	9.1	280.3	451.4	62	68.7	103.9	66
RUS	9.2	287.5	462.0	62	63.7	100.7	63
ESP	7.9	216.0	358.9	60	58.7	95.3	62
FRA	8.7	234.3	406.9	58	55.1	91.6	60
KOR	7.3	222.0	383.6	58	46.0	84.3	55
Ave.	8.4	247.9	413.5	59.8	59.1	94.3	62.5

According to Table 4, the Netherlands had the highest success rate of 69% in shooting, followed by Norway (66%), Russia (63%), Spain (62%), and France (60%), and South Korea had the lowest success rate of 55%. Norway had the highest score of 63 percent, followed by Russia (61%), Spain (56%), the Netherlands (55%), and France (53%), and South Korea (57%). The 9m shot was the highest in the Netherlands with 42%, followed by Russia (41%), Spain (40%), Norway (39%), and France (37%), and South Korea (39%). Russia and Norway had a relatively low success rate of 58% in the average success rate of 6m, Wing, and 9m field shots.

Table 5. Comparison of South Korea's field shot success rate with the top five women's handball teams in the world(Wing, 9m)

Teams	M	Wing			9m		
		Goals	Shots	%	Goals	Shots	%
NED	8	35.8	64.6	55	60.2	142	42
NOR	9.1	37.7	60.3	63	49.7	128.9	39
RUS	9.2	38.2	63.0	61	52.7	127.5	41
ESP	7.9	33.0	59.4	56	32.0	80.4	40
FRA	8.7	27.9	53.0	53	45.3	120.9	37
KOR	7.3	35.3	61.6	57	41.1	104.3	39
Ave.	8.4	34.6	60.3	57.3	46.8	117.3	39.8

When focusing on Table 6's 7m shot, fast ball, and success rate of 1:1, Russia was the highest with 81%, followed by the Netherlands (78%) and Norway (75%) and South Korea had 74% success rate same as Spain and France. In the case of swift attack, Norway had the highest success rate of 80%, followed by Russia (76%), Spain (74%), France (74%), and the Netherlands (70%) and South Korea had a success rate of 77%. Norway and Russia had the highest success rate of 79%, followed by the Netherlands (78%), France (77%), and Spain (76%), and South Korea had the lowest success rate of 72%.

Table 6. Comparison of South Korea's field shot success rate with the top five women's handball teams in the world(7m, FB, BT)

Teams	7m			Fast Breaks			Breakthroughs		
	Goals	shots	%	Goals	shots	%	Goals	shots	%
NED	19.4	25	78	46.4	66	70	21.8	27.8	78
NOR	30.1	40.1	75	70.1	87.1	80	24.1	30.4	79
RUS	32.0	39.7	81	65.0	85.2	76	33.7	42.8	79
ESP	28.4	38.6	74	32.6	44.3	74	29.6	38.7	76
FRN	25.0	33.7	74	55.3	74.4	74	25.1	32.6	77
KOR	33.4	45.3	74	42.7	55.7	77	22.1	30.7	72
Ave.	28.1	37.1	75.8	52.0	68.8	75.3	26.1	33.8	77.0

Similarly, when focusing on Table 7's attacks and defensive attacks, Norway had the highest number of assists during the attack with 160.7 times, followed by Russia (130.7 times), the Netherlands (123.2 times), France (116.4 times), and Spain (108.6) and South Korea with 112.7 times. Russia had the highest number of Technical Faults with 131.8 times, followed by France (126.9 times), Norway (122.1 times), Spain (120.3 times), and the Netherlands (96.4 times), and South Korea had the lowest number of errors (TFs) with 89.6 times. During defense, France had the highest number of steals with 47.6 times, followed by Russia (46.7 times), Norway (42.7 times), the Netherlands (38.8 times), and Spain (37.4 times). South Korea ranked the lowest with 36.7 times. Russia had the highest block shots with 44.7 times, followed by the Netherlands (33.8 times), France (31.1 times), Norway (27.7 times), and Spain (20.4 times). South Korea recorded the lowest number of 12.9 times.

Table 7. Comparison of Field Shot Offence and Defence Success Rate with Top 5 World Women's Handball Teams

Teams	Offence		Defence	
	Assists (AS)	Turnovers (TO)	Steals (ST)	Blacked shots(BS)
NED	123.2	96.4	38.8	33.8
NOR	167.0	122.1	42.7	27.7
RUS	130.7	131.8	46.7	44.7
ESP	108.6	120.3	37.4	20.4
FRA	116.4	126.9	47.6	31.1
KOR	112.7	89.6	36.7	12.9
Ave.	126.4	114.5	41.6	28.4

Regarding the penalty in Table 8, Norway received the most Yellow Cards with 22 times, followed by France (21.9 times), Russia (20.5 times), Spain (18.7 times), and the Netherlands (16.8 times). And Korea appeared with 18.6 times. Among the penalties, 2-Minute Suspensions were highest in Russia with 36.2 times, followed by the Netherlands (30), Spain (29.4), France (29.1), and Norway (27.3). Korea showed with a very low rates of 18.1 times. As for the Red Card, Norway 2 times, Spain (1.3 times), the Netherlands, Russia, and France each showed 1 time, and Korea 4 times showed relatively many red cards.

Table 8. Comparison of Korea's Penalties with the Top 5 Women's Handball Teams

Teams	Penalties		
	Yellow Cards	2 Min.	Red Cards
NED	16.8	30	1
NOR	22.0	27.3	2.0
RUS	20.5	36.2	1.0
ESP	18.7	29.4	1.3
FRA	21.9	29.1	1.0
KOR	18.6	18.1	4.0
Ave.	19.7	28.4	1.7

3.3 Comparison of Attack Success Rate by Location of Top 5 Teams and South Korea

When comparing the 'attacks by location' of the top five women's handball teams from 2007 to 2019, it shows the results as Table 9, Table 10 and Table 11. According to Table 9, left Wing shooting success rate was 58% in average, and Russia had the highest success rate of shooting in the left wing with the success rate 65%, followed by Norway (63%), the Netherlands (59%), South Korea (57%), France (54%) and Spain (49%). South Korea was under average of shooting in the left wing. In Left 6m shooting, the shot success rate was 56% on average, and Norway had the highest shot success rate of 62%, followed by Spain (60%), the Netherlands (60%), France (58 %), and Russia (50 %), and South Korea had the lowest success rate of 47

%. The left-hand 9m shoot averaged 40%, and the Netherlands was the highest with 46%, followed by South Korea (42%), Russia (40%), Spain (39%), France (37%), and Norway (35%) and South Korea's success rate was above average.

Table 9. Comparison of Offence Success Rate by Location with Top 5 World Women's Handball Teams(Left Wing, 6m, 9m)

Teams	M	Left								
		Wing			6m			9m		
		Goals	Shots	%	Goals	Shots	%	Goals	Shots	%
NED	40	83	140	59	62	103	60	93	202	46
NOR	64	126	199	63	98	158	62	66	186	35
RUS	55	111	172	65	77	154	50	73	184	40
ESP	55	90	184	49	86	143	60	47	121	39
FRA	61	101	188	54	103	177	58	68	186	37
KOR	51	107	188	57	63	135	47	64	154	42
Ave.		103	178.5	58	81.5	145	56	68.5	172.2	40

In the average success rate of the left wing, 6m, and 9m field shots, South Korea had a low success rate in both 6m and 9m shooting. According to Table 10, the Netherlands had the highest shot success rate of 68% in the center, followed by Norway (72%), Russia (72%), France (65%) and Spain (65%) and South Korea had the lowest success rate in the 6m center shooting. The average success rate of 9m shooting in the center was 40%, followed by Russia (42%), Norway (40%), Spain (40%), South Korea (40%) and France (38%). In the average success rate of the 6 m and 9 m field shots, South Korea showed a lower average success rate in 6 m shooting, but in 9m showed the average success rate.

Table 10. Comparison of Offence Success Rate by Location with Top 5 World Women's Handball Teams(Center, 6m, 9m)

Teams	M	Center					
		6m			9m		
		Goals	Shots	%	Goals	Shots	%
NED	40	171	223	77	165	388	43
NOR	64	294	408	72	195	485	40
RUS	55	201	278	72	185	436	42
ESP	55	217	333	65	136	341	40
FRA	61	215	332	65	190	495	38
KOR	51	155	276	56	153	386	40
Ave.		208.8	308.3	68	170.7	421.8	40

According to Table 11, the average shot success rate in the right wing was 57%, and Norway showed the highest rate with 62%, and it was followed by Spain (61%), Russia (57%), Korea (57%), the Netherlands (52%), and lastly France (51%). Fortunately, Korea's right wing shot success rate was higher than the average. The right 6m shot success rate averaged 57%, with the Netherlands the highest at 63%, followed by Russia (60%), Spain (56%), Korea (56%), Norway (54%), and France (52%). Korea showed a success rate lower than the average with the rate of 56%. The 9m shot on the right averaged 39%, with Spain showing the highest rate at 44%, followed by Russia (40%), Norway (38%), Korea (38%), France (37%), and the Netherlands (37%). Korea's success rate was under average, showing the rate of 38%.

Table 11. Comparison of Offence Success Rate by Location with Top 5 World Women's Handball Teams(Right Wing, 6m, 9m)

Teams	M	Right								
		Wing			6m			9m		
		Goals	Shots	%	Goals	Shots	%	Goals	Shots	%
NED	40	96	183	52	72	115	63	43	117	37
NOR	64	138	223	62	86	158	54	87	227	38
RUS	55	118	206	57	99	165	60	58	143	41
ESP	55	141	232	61	106	188	56	41	94	44
FRA	61	94	183	51	67	130	52	58	155	37
KOR	51	140	243	58	89	160	56	70	185	38
Ave.		121.2	211.7	57	86.5	152.7	57	59.5	153.5	39

When estimating the average success rate of the right wing, 6m and 9m field shots, Korea showed a high success rate in the wing, and a low success rate in the 6m and 9m field shots. According to Table 12, the average success rate of a breakthrough shot at 1:1 situation was 77%, and Russia and Norway ranked the top with the rate of 79%, followed by the Netherlands (78%), France (77%), Spain (76%), and Korea (72%). Korea showed the lowest success rate of a breakthrough shot at 1:1 situation than the average. The average success rate of

quick-shooting was 76%, and Norway was ranked at the highest with the rate of 80%, followed by Korea (77%), Russia (76%), Spain (74%), France (74%), and the Netherlands (52%). Korea showed a higher-than-average success rate of 77%. When estimating the fast shooting and breakthrough in the 1:1 situation, Korea showed a low success rate for breakthrough shots, and a high success rate for fast attack shots.

Table 12. Comparison of Offence Success Rate by Location with Top 5 World Women's Handball Teams(BT, FB)

Teams	N	Breakthroughs			Fast Breaks		
		Goals	Shots	%	Goals	Shots	%
NED	40	109	139	78	232	330	70
NOR	64	169	213	79	485	610	80
RUS	55	202	257	79	390	511	76
ESP	55	207	271	76	228	310	74
FRA	61	176	228	77	387	521	74
KOR	51	155	215	72	299	390	77
Ave.		169.7	220.5	77	336.8	445.3	76

Table 13. Comparison of Offence Success Rate by Location with Top 5 World Women's Handball Teams(7m, Empty Goals)

Teams	M	7-metre Shots			Empty Goals(EG)		
		Goals	Shots	%	Goals	Shots	%
NED	40	97	125	78	7	16	44
NOR	64	178	240	74	4	9	44
RUS	55	192	238	81	14	21	67
ESP	55	199	270	74	12	22	55
FRA	61	175	236	74	5	15	33
KOR	51	234	317	74	10	17	59
Ave.		179.2	237.7	75	8.7	16.7	52

According to Table 13, the average shot success rate at 7m was 75%, and Russia ranked at the top with the rate of 81%, followed by the Netherlands (78%), France (74%), Spain (74%), Norway (74%), and Korea (74%). Korea's shooting success rate at 7m ranked lower than average. <Table 13> also showed the average success rate of empty shots. The average success rate was 52%, and Russia again ranked at the very top with the rate of 67%, followed by Korea (59%), Spain (55%), the Netherlands (44%), Norway (44%) and France (33%). Korea showed a higher-than-average success rate of 59%. In

the average success rate of 7m and empty shots, Korea showed a low success rate with 7m shots and a high success rate with empty shots.

4. Discussion

This study's major target is to compare, contrast, and analyze both the key scoring paths and attacking/defending success rates based on various shooting types of the top five women's handball teams (Netherlands, Norway, Russia, Spain, and France) from the 2007-2019 World Women's Handball Championships and Korean women's handball team. When comparing physical conditions of the female handball players of Korea and the top five women's handball teams in the world from 2007 to 2019, it was found that height and weight was the biggest difference between Korean players and the others.

Handball is considered as one of the most interesting fields for sport science analysts due to its diverse movement patterns and the diverse capabilities required to achieve top-notch results [15,16]. Measurements of physical (Human body analysis and body type) and physiological characteristics provide great insight into the current state of handball players, and coaches can assess and evaluate these players and decide the time and intensity of training to improve their skills [17-19]. Athlete profiling can be a useful tool in identifying talents, determining strengths and weaknesses, assigning positions, and optimizing the design of strength and conditioning training programs [20-22].

A player's scoring is a major contributor to a team's success, and it depends on various factors. That is, it is determined by the strength of the aggressive player or the group action that surpasses the individual skill, the individual action, or the weak individual skill of the

defender [23].

When delving into the previous studies dealing with the success rate of handball field shots and attacks by position, in terms of 'fast attack efficiency'-which is a key element of modern handball- European teams had less chance of fast attack in their own leagues of competition. However, in various championships such as the Olympics and World Championships, which they have to play game with non-European opponents and teams, the number and effectiveness of quick-attack actions have increased. This was the most important advantage of European teams, both strategically and physically [24,25].

Alexandru, Alexandru, & Ion [26] When choosing the most effective scoring shooting positions based on the cumulative statistics of the 2009 World Championships, fast shooting (88.23%) was ranked at the very top, followed by 1:1 breakthrough shooting (75%). As a result of analyzing the contribution of the goal situation to the score, it was found that the pivot position efficiency was the second highest at 15.63%. Ohnjec, Vuleta, Milanović, & Gruić [27] At the 2003 World Women's Championships in Croatia, a fast-paced goal had a positive effect on the difference in goal gain and that successful teams took advantage of the time to score "easy goals" more often than losing teams.

Srhoj, Rogulj, & Katić[28] mainly analyzed the influence of 18 indicators on the location direction of the final action of an attack on the outcome of the match. Research has shown that players in the center position performed the final performance of the attack more often compared to other players in other positions. The most effective way of shooting was presented in when the player was able to shoot a situational and short-range shooting.

Rogulj [29] had the goal of determining

duration, continuity, system and structure of shooting attacks and offensive group tactics which is helpful to better distinguish the winning teams among the losing teams. In the study, the researcher used 27 performance indicators related to the team's competitive success. The main results showed that the winning team was more efficient in individual actions of quick turnaround and attack progression. During the defense time, the winning team implemented the defensive element more efficiently, the losing team made several mistakes and shot inefficiently in most field positions.

As the previous studies suggested, the rapid attack and the one-on-one breakthrough were the most emphasized part among the various attacking skills. When analyzing the game results of the world top five women's handball teams and Korea, Korea relatively showed the high success rate in Wing and end-line shots. Therefore, when reinforcing the parts such as Left, Right, and Center field shootings, and developing new tactics and strategies to increase the speed of the shooting and attacks, Korean team would be much competitive to achieve great results from World Championships and the Olympics. field shots at positions such as the left, right and center, which showed relatively low success rates due to high success rates in wing and end-line shots, I think that if you reinforce your shooting skills and strategies to increase your speed in attack, you will be able to achieve excellent results at the World Championships and the Olympics.

5. Conclusions and Recommendations

The purpose of the study was to analyze and strengthen the capacity and skills of the Korean women's handball team by analyzing the game managing skills of the top five countries which had outstanding results from 2007-2019 World

Women's Handball Championships. Based on this research objective, the following conclusions were obtained by analyzing 7 game records between the top 5 countries and Korea.

First, when focusing on height among various physical conditions, Russia, Norway, the Netherlands, France, and Spain were in order, and in the case of Korea, it was 1.8 cm smaller than that of Spain, which was ranked at the very bottom of the top five teams. When focusing on the average weight, the Netherlands was ranked at the top and Russia, Spain, and France followed in order. Korean players' average weight was 65.7kg and was the lightest. In terms of average age, Spain was the highest, and the Netherlands was the lowest - 24.7 years. It is judged that the physical condition of Korean handball players is inferior to the top five teams, such as height and weight. From this point, it is necessary to suggest various attack and defense method in consideration of the physical condition in the future.

Second, when delving into the success rate of the 6m field shot, Korea showed the lowest success rate, and showed 57% of success rate from the wing shot. From the 7m shot shooting success rate, Korea's rate was similar to that of Spain and France. Korea showed its 9m shot success rate as 39%. The average success rate of 6m, Wing, 7m, and 9m field shots was shown high in Russia and Norway, and Korea relatively showed a lower rate. As for the success rate of 1:1 breakthrough, Korea also showed a relatively low success rate.

Third, when comparing the 'attack success rate by location', Korea showed a low success rate from left wing, 6m, 9m, center 6m, right 6m, 9m, showed the average success rate in the center 9m, and a high success rate from the right wing. Plus, Korea showed a low success rate in 1:1 breakthrough shot and 7n shots but showed high

success rates in fast-through shots and empty goals.

In addition, it is expected to be used as basic data for improving the performance of Korean female handball players and to raise the level of the game in the 2021 Tokyo Olympics women's handball game. Lastly, the Korea Institute of Sports Policy and Science (former Institute of Sports Science) has continuously contributed to improving athletic performance through analyzing and applying sports science. The application of sports science in the sports field refers to a concept which means 'systematically analyzing and establishing new sports science theory and apply it to leaders and athletes in the field'. It is a very specialized part that requires specialization and a lot of know-how for each sport characteristic. The Institute of Sports Science has introduced a system of assigning researchers to each sport field to improve the performance of national athletes, and separately researchers belonging to the Sports Science and Industry Lab are now assisting and supporting the other parts. Especially, Sports science supporting team and its researchers mainly find out the factors of performance from each sport field and provides intensive support for each major such as physiology, epidemiology, psychology, and nutrition. Especially in the years which has big sports events such as the Olympics and Asian games, its role becomes more crucial. To ensure that the sports science support team, which is striving to develop individual competencies of the team's athletes, is working well, it is recommended that various supporting plans from the government and private organizations should be secured so that the current sports science supporting team, and further our athletes, could be smoothly supported.

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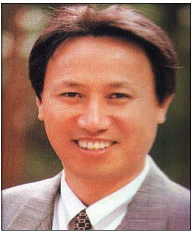


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