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Original Article

Performance indicators and competition ranking in Women's and Men's World Handball Championship 2017

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Abstract:
The study aims to evaluate the efficacy of specific performance indicators in the final competition ranking of national handball teams, of different competitive levels on a world scale. Also, an attempt was made to portray to what degree the examined performance indicators influence game performance. Additionally, an attempt was made to clarify to what degree the observed indices affect the final ranking. The collected data comprised eight indices: a) Age (years) b) Body Height (cm) c) Body Mass (kg) d) International Matches played e) International Goals scored f) Total Shots per player g) Total goals per player h) Team Scoring Efficiency (%). These indices were grouped into: i) Anthropometric index that includes, a) Body Height (cm) b) Body Mass (kg) (ii) Game experience indices that include a) Age (years) b) International Matches played c) International Goals scored, (iii) Performance efficacy indices that include a) Total Shots per player b) Total goals per player c) Team Scoring Efficiency (%). Descriptive statistics were used (mean, standard deviation), a comparison between the group with ONE-WAY-ANOVA followed by non-parametric correlation Spearman's rho and Factor analysis. Placing the indices in order of hierarchy by our results, the most critical parameters in the ranking of the men's teams is game experience and anthropometric index that influence the final team ranking. As far as the women's groups are concerned, the index that played a vital role and affects the final ranking, in order of importance, are performance efficacy, game experience indices, follow anthropometrically and finally Team Scoring Efficiency.
Keywords*:* competitive level, national teams, performance analysis

Introduction

Achieving top performance in handball depends on many factors such as technical skills, tactical abilities, physical and anthropometric characteristics of the athletes. (Rousanoglou et al., 2014).Game performance in Handball World Championship has pronounced coaching and scientific interest as it relates to the development of the sport not only by physical characteristics but also of tactical abilities. The analysis of top performance competition like the World and European championships as well as Olympic events is a necessity to determine current developments in handball (Taborsky, 2007). Data analysis for every period illustrates the prevailing trend of the sport and constitutes a standard of measure between the different periods (Meletakos et al., 2010).Today, the outcome of a game of handball lies in the small details of the match especially at such highly competitive levels, transforming the analysis into a decisive factor by providing both evaluation and guidance in the coaching process. (Willian et al., 2014).

The variety of movement in handball makes it one of the most complex (Roguljet al., 2004) multifactorial athletic games and especially trying to discriminate the specific parameters that affect performance (Wagner et al., 2014). According to Hassan et al. (2013), there is clear discrimination both qualitatively and quantitatively between national teams that achieve top performance in high-level competitions. The published studies in handball (Georgiana and Aurelia, 2014; Bilge M, 2012; Foretić et al., 2010; Ohnjec et al., 2008; Gruić et al., 2005) are based mainly upon game data analysis or video analysis. The data analysis approach comprises descriptive statistics, frequencies, and percentage of different performance indicators that provide information about the game. Some studies in handball deal with game performance indicators and anthropometric characteristics of top-level athletes (Chaouachi et al., 2009), athletic experience (Skarbalius, 2009), critical offensive performance indicators (Meletakos et al., 2011) and the relation with the final ranking of the team. The athletes' anthropometric characteristics affect their performance up to a point and possibly differentiate high-level players (Chaouachi et al., 2009; Milanese et al., 2011; Rousanoglou et al., 2014). The athlete's experience is a significant factor in his team success (Weber J., Wegner M., 2016). In most studies, the efficacy of game performance indicators, for every team, provide valuable and objective data to enable game evaluation. (Rogulj

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et al., 2004; Bilge M., 2012; Daza et al., 2017). Game performance indicators analysis allows the coach to focus on those indicators that influence the outcome of the game (Hughes MD and Bartlett RM, 2002). According to O'Shaughnessy (2006) and Wagner et al. (2014), determining the deciding indicators may lead to a performance profile that predicts the outcome. Therefore, there is a great necessity to expand our knowledge of those indicators that dictate success and differentiate the successful and unsuccessful teams. The study aims to evaluate the efficacy of specific performance indicators in the final competition ranking of national handball teams, of different competitive levels on a world scale. Also, an attempt was made to portray to what degree the examined performance indicators influence game performance.

Material and Methods

Participants

Our sample consisted of the total number of women and men of the national teams that participated in The Men's World Championship in France (21-29/1/2017) and Women's in Germany (1-17/1/2017). The choice of selected teams was made according to their final ranking. First group (G1), the teams that were in the 1st, 2nd and 3rd positions, Second group (G2), the teams that were in the 9th,10th and 11th positions and the third group (G3), the teams that were in the 22nd,23rd and 24th positions. The total number of men athletes, (men's group, MG) and women athletes (women's group, WG) was 144 for each group.

Measures

The data collected was from the official Box Scores of the International Handball Federation http://www.ihf.info and included all the game statistics of the World Men's and Women's Championships 2017. The collected data comprised eight indices: a) Age (years) b) Body Height (cm) c) Body Mass (kg) d) International Matches played e) International Goals scored f) Total Shots per player g) Total goals per player h) Team Scoring Efficiency (%). These indices were grouped into: i) Anthropometric indices that include a) Body Height (cm) b) Body Mass (kg) (ii) Game Experience indices that include a) Age (years) b) International Matches played c) International Goals scored (iii) Performance Efficacy indices that include a) Total shots per player b) Total goals per player c) Team Scoring Efficiency (%).

Statistics

Descriptive statistics were used (mean, standard deviation), a comparison between group (ONE-WAY-ANOVA) with POST-HOC=BONFERRONI ALPHA (0.05). Non-parametric correlation Spearman's Rho was used between ranked teams and the remaining parameters ($p<.05$). Factor analysis was run with the three-factor criteria with ROTATION VARIMAX with the level of significance $p<.05$.

Results

Table 1 shows the averages, and standard deviations (x ± sd) of this age, anthropometrics, game experience and performance efficacy indices and the levels of statistical significance among the three men study groups.

Table 1. Descriptive statistics (x ± sd) of the age, anthropometrics, game experience and performance efficacy indices and the levels of statistical significance among the three men study groups.

	Descriptives x ± sd)				Statistics oc comparisons (p-value)		
Variable	MG1	MG2	MG3	)	MG1-MG2	MG1-MG3	MG2-MG3
Age (years)				05)	Ns	Ns	
Body Height (cm)		5		00)*			
Body Mass (kg)				00) *			
Int. Matches Played		2		2) *			
Int. Goals Scored	7.3	3.5	4.3	49)			
Total Shots per Player				4) *			
Total Goals per Player				0) *			
Team Scoring Efficiency (%)				6) *			

MG1=Men First group MG2=Men Second Group MG3=Men Third Group Int. =International

Statistically significant differences were observed between MG of our study in Body Height (BH), Body Mass (BM), some International Matches Played, Total Shots per player, Total goals per player and Team Scoring Efficiency. The Post hoc test with correction Bonferroni for BH, BM, International Matches played and Team Scoring Efficiency index showed statistically significant differences between MG1 and MG3, between MG2 and MG3, but no statistically significant differences were observed between MG1 and MG2. The Total Shots per player and Total goals per player index in the Men's World Championship (WCh/2017) exhibits statistically significant difference only between MG1 and MG2.

Table 2 shows the averages and standard deviations (x ± sd) of this age, anthropometrics, game experience and performance efficacy indices and the levels of statistical significance among the three Women groups.

Table 2. Descriptive statistics (x ± sd) of the age, anthropometrics, game experience and performance efficacy indices and the levels of statistical the significance among three women study groups

	Descriptives (x ± sd)				Statistics hoc comparisons (p-value)		
Variable	WG1	WG2	WG3	)	WG1-WG2	WG1-WG3	WG2-WG3
Age (years)	27.4±3.5	27.6±3.9	25.4±3.9	4.95(0.008) *	Ns	0.037	0.014
Body Height (cm)	)	)	.	'23)		Ns	Ns
Body Mass (kg)				;75)	Ns	Ns	
Int. Matches Played	7		)	)00) *		0.000	
Int. Goals Scored	214.6±221.6	2.2	9.3	·6)*		0.046	
Total Shots per Player		)	;	)3) *		0.003	
Total Goals per Player				)0)		Ns	
Team Scoring Efficiency (%)	61.7±11.6	62.3±15.8	48.1±16.5	12.11 (0.000) *	Ns	0.000	0.000

WG1= Women First group WG2= Women Second Group WG3=Women Third Group Int. = International

In WG statistically significant differences were observed in age, the number of International Matches Played, International Goals scored, Total goals per player in 2017 World Handball Championship and Team Scoring Efficiency. Statistically significant differences were observed in age and Team Scoring Efficiency between WG1 and WG2 with WG3. Additionally, statistically, significant differences were seen in the International Goals scored only between WG1 and WG3 and in International Matches played, Goal scored per player in WCh/2017 between WG1 with WG2 and WG3.

Statistically, a significant correlation can be seen between the final ranking and indices of the MG, BH (r=-.405**, (000), BM (r=-.347**, (000), International Matches played (r=-.194*, (021), goals per player in 2017 World Championship (r=-.206*, (013) and Team Scoring Efficiency (r=-.217**, (009). In women's, statistically significant correlation can be observed between final ranking and Age (r=-.200*, (016), International Matches Played (r=-.282**, (001), International Goal scored (r=-.180*, (038), Goal scored per player in WCh/2017 (r=-.281**, (002) and Team Scoring Efficiency (r=-.414**, (000).

Table 3 shows Factor Analysis based on a three-parameter criterion. In men's WCh/2017, the first factor (which could also be called a factor Experience) accounts for 28.8%, the second (which could also be called a factor Performance) for 28.3%, the third (which could also be called a factor Anthropometric) 22.1% and thus total weighting of 79.23%. In women's WCh/2017, the first factor (which could also be called a factor Performance and Experience) accounts for 37.6%, the second (which could also be called a factor Anthropometric) for 22.6%, the third (which could also be called a factor Performance) 17.6% and thus a total weighting of 77.92 %.

Table 3. Factor Analysis Men's Women's WCh/2017. Rotated Component Matrix

	Men				Women		
	1 Exper	2 Perform	3 Anthr		1 perform+Exper	2 Anthr	3 Perform
International Matches Played	**0.94**	0.05	0.13	Total Shots per Player	**0.92**	-0.06	-0.24
Age	**0.86**	-0.19	-0.10	Total Goals per Player	**0.88**	-0.12	-0.01
International Goals Scored	**0.81**	0.39	-0.07	International Goals Scored	**0.79**	0.07	0.33
Total goals per Player	0.10	**0.91**	-0.05	International Matches Played	**0.74**	0.23	0.42
Total shots per Player	0.09	**0.90**	-0.12	Body Height	0.02	**0.91**	-,073
Team Scoring Efficiency (%)	-0.05	**0.67**	0.11	Body Weight	-0.03	**0.89**	0.09
Body Height	-0.09	0.04	**0.93**	Team Scoring Efficiency (%)	-0.07	-0.12	**0.81**
Body Weight	0.07	-0.07	**0.92**	Age	0.45	0.32	**0.63**

Anthr =Anthropometric Exper =Experience Perform = Performance

Discussion

The results show that six out of the nine teams analyzed are from Europe while the remaining three which hold the last three positions in the final ranking come from non-European countries. These results are consistent with the results of other studies (Hasan et al., 2007; Bilge M., 2012) with mainly European teams holding the top positions in international competition (Olympic Games, World Championships). The consensus is that over the years game at a high level can be seen mainly by European teams.

The average age was 27.5 ± 4.2 for men and who are experienced (enough) being a member of a team. The 23-28 age range represents the optimum combination to acquire game experience (Michalsik et al., 2015). The three MG were not statistically significant in age. Participation in the top level competition is related to age as it is supposed that a higher average age team implies more games and therefore more experience. According to Schorer (2007) and Milanese et al. (2011), the frequency of playing in highly competitive leagues is one of the parameters that measure game experience and seems to be an essential factor in team success. Moreover, Anders Ericsson & Lehmann (1996) state that expertise can best be measured through games at high- level competition. This may be explained by the fact that more experienced players play in top-level competition (Milanese et al., 2011). The top three MG of the final ranking shows a significant difference in international participation. Also, the number of foreign involvement of the MG in our study is related to classification. According to Skarbalius (2011), experience may play an essential role in winning Olympic or European Championships. More experienced players are better at foreseeing their opponents' reactions, (Roca et al., 2011; Venter S. C., Ferreira J. T., 2004) controlling their emotions more efficiently (Maxwell et al., 2009) and exhibit a significant difference in mental abilities compared to less experienced players (Gonzales et al., 2013). Through derivatization, game experience and age constitute the first component of the factorial standard. Consequently, top athletes are characterized by excellent game experience that resulted in the primary criterion for the successful performance and final ranking of the three MG.

Concerning for women age was 26.8 ± 3.9, and the results showed significant differences between the three WG. In the study Ghobadi et al. (2013) in the 2009 World Women's Handball Championship, the average age of the more successful teams was higher than the other teams. The WG in our study showed marked differences in the number of international participation and number of goals scored in international games. The number of foreign involvement of WG is connected with the final ranking. Ghobadi et al. (2013) found that substantial experience in women athletes had more of an impact than anthropometric characteristics on winning a game. Consequently, game experience seems to be an essential criterion in WG success. In the factorial standard, the experience provided part of the first component while age was the third of the WG in our study. Consequently, women handball players with more game experience have more chances to win a game (Schneider et al., 2007; Skarbalius, 2009) because they show greater maturity and a higher level of competitiveness to solve critical situations in the game.

BH is a necessary and essential element in team success and a criterion of athletes' expertise. According to Hasan et al. (2007), the most successful teams are taller than the less successful ones. Wagner et al. (2010) concluded that BH and BM might greatly influence the game performance in modern handball. The study by Globoid et al. (2013), which dealt with the participating teams in the 2013 World Men's Championship, illustrated that physical characteristics influence player performance during the game and constituted a clear distinction in success towards the final ranking. In the data analysis of the current study, MG was significantly different, in both BH and BM. However, if we compare the results of MG, MG2 of the final ranking in our study, we witness similar values to the corresponding average value in the last five World Championships that correspond to BH =191.7± 0.8 cm και BM =93.1±1.6 kg. In the study by Globoid et al. (2013) dealing with the participating teams in the 2013 World Men's Championship, athletes that finished in the first group of four had much greater BH and BM than those athletes of teams that finished in the last positions. The results of our study confirm that the significant correlation between the final ranking of MG and BH and BM had a positive effect on the final ranking of teams in the 2017 World Men's Handball Championship. Through derivatization, BH and BM constitute the third component of interpretation of the factorial standard. Consequently, physical characteristics affect player performance during the game and represent the vital factor for success in the final ranking. Over the last few decades, the increase in BH and BM was not so evident among handball players, as among top/ high-performance handball players (Michalsik et al.2011). The analysis of the data in the current study shows no differences between the three WG in BH as well as in BM. The average values of BH, BM of the three WG in our study were similar to the average values of the three top teams in the final ranking that took part/appeared in the last five World Championships (BH =177.1± 1.1 cm and BM =69.8±0.5 kg). The weighting of BH and BM is different about the different game positions. Despite the critical significance of BH and BM and other elements such as technical and tactical characteristics, physical condition, and change of speed or direction that manifest themselves in a short space of time can counterbalance women handball players who have lower BH and BM.

Moreover, there was no correlation between final team ranking and BH and BM respectively. Through the analysis of the data, we can suppose that the average values of BH and BM displayed by the three WG have almost reached their maximum. Consequently, other parameters besides BH and BM seem to have a decisive

influence on team success. In the factorial profile of WG, the somatometric characteristics appear as a second analysis component that looks to explain the final ranking of teams in World Handball Championship 2017. These findings show that the last ranking is influenced primarily by technical and tactical abilities followed by anthropometric parameters.

The indices of game performance showed statistically significant differences in both MG and WG of the final ranking. In fact, MG revealed substantial differences in the three-game performance indices used. According to Bilge (2012), Daza et al. (2017) the number of shots per game could be an acceptable index to assess game performance and is an essential variable in their total production. Analyzing the differences in the name of attempted shots and the total number of goals scored in the W.H.C of 2017 showed significant differences only between MG1 and MG2. The results further indicate that they seem to agree with the conclusions of Srhoj et al. (2001), who analyzed the Men's World Handball Championship in Egypt, which say that success depends on the number of shots not only quantitatively but also qualitatively. As far as the appearance of MG, the number of successful goal attempts as well as percentage efficacy significantly correlate with ranking. In a previous study by Rogulj N. (2000) on Men's World Handball Championship in Egypt, it showed statistically significant differences in frequency and shot efficacy about team success. In another study by Daza et al. (2017) on the 24th Men's World Championship 2015 in Qatar, the statistical game data showed that successful goal attempts and shots correlate with the outcome of the game. In the factorial analysis, all the indices of game performance constitute the second component of the factorial standard. Consequently, the percentage efficacy seems to influence the final result of the game much and distinctly differentiates the three MG based on their last ranking. In WG the variables that exhibited significant differences were the average frequency of successful goal attempts as well as the average attack efficacy that both correlate with the final result. The study by Kniubaitė A., Skarbalius A. (2012) στο World Women's Handball Championship, 2009 (WWHC, 2009) showed that the first four teams of the final ranking scored more goals (149 ± 149) on average compared to the groups that held positions 13 to 24 (84 ± 128). In the factorial analysis, the shot frequency and successful goal attempts participate in the first component of the factorial standard while the percentage attack efficacy appears in the third. Consequently, it is possible that the successful goal attempts are the most critical game performance index that gives the advantage to teams who were ranked in the top position of the particular championship.

Conclusions

Placing the examined indices in order of importance was: a) for the three MG, first in line is game experience, anthropometrics index, percentage attack efficacy and b) for the three WG early in line is performance efficacy, game experience, anthropometric indices and finally Team Scoring Efficiency.

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