Contribution to methodology of efficiency evaluation of handball goalkeepers

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ABSTRACT

Goalkeepers have a very important role in handball, especially in maintaining team morale. In coaching communities, it is well recognized that goalkeepers' performances can predict team ranking in major tournaments (Hansen at al.,2017). There are different systems for assessing players, goalkeepers and team's performance in handball. There is also the need of evaluating the performance of individual players during the game - this evaluation can contribute to a better determination of the tactic's activities of a team. Therefore, the purpose of this study was to analyse goalkeepers' save performance comparing three evaluation methods. The 28 goalkeepers from all 16 national teams of the 2018 men's European Championships tournament were analysed using three methods (save percentage, saves/time and new method). A significant relationship was not identified between the goalkeepers ranking in these three methods using Friedman ANOVA test (p=0.29). **Keywords**: Handball goalkeepers; Performance evaluation; Saves.

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INTRODUCTION

The European Handball Federation (EHF) organizes the Handball European Championship every two years since 1994. The most recent was held in Croatia, 2018 (Men's European Championship). Most performance-related research conducted in handball has focused on the physical requirements of field players, specifically locomotion demands and body contacts (Cardinale at al., 2016). Despite the recognition of the importance of goalkeepers in handball, very few studies have been conducted on performance characteristics of elite goalkeepers. The goalkeepers' role is to prevent the opposing team from scoring goals by blocking the ball using the whole body (goalkeepers are allowed to touch the ball with everybody part, unlike field players) within the goal perimeter. The most important performance indicators often identified are the 'save' statistics (Manchado et al., 2013). The percentage of saves and their relationship with the position of the thrower are usually presented as the main indices of performance analysis of goalkeepers (Meletakos et al., 2011). A recent analysis of Olympic, World and European tournaments (Hergeirsson, 2008.) has highlighted the influence of goalkeepers on game results (Bilge, 2011).

Goalkeepers in team handball perform solely and must concentrate on a quick and explosive execution of a movement in a restricted space and in a flash, as it is important for the acceleration of his body and his arms (Hatzimanouil et al.,2017). As goalkeepers play a key role in handball, understanding how they perform during a tournament could improve training methods, and more detailed analyses of goal-keeping performance can better inform our understanding of their relative contribution to match and tournament success. Therefore, considering the lack of data on elite goalkeepers, the aim of the present study was to analyse the match demands and goalkeepers saving efficiency during the 2018 European Championships using three different methods of evaluation. The main hypothesis was that a new method (Cvenić, 2008) of goalkeepers' efficiency evaluation will be a different and get a different individual ranking than existing two methods, percentage of saves and saves/time.

METHODS

The 16 handball male teams in the European Championships 2018 played 47 matches. Every team played with 2 to 3 goalkeepers on the roster. In total, 28 goalkeepers (more than 1 game= 60 minutes spent on the goal) were compared during the championship using all three methods of ranking. During each game important handball actions were coded: goals scored, shots attempted, area of throws in the handball goal, area of saves in the handball goal.

The most used statistic method for evaluate goalkeepers is save percentage. Number of goalkeepers saves divided with number of players shots on goal, multiplied with 100. Most high-level goalkeepers in a typical game make around 35% save percentage. The limitations of this method are that it cannot compared goalkeepers who spent different time on goal and different number of played games. For example, the goalkeeper who had a high save percentage in one game is better than other goalkeeper who had a lower save percentage, but he was on the goal for three games. The goalkeepers' efficiency (Eg) has been calculated according to the formula:

$$Eg = \frac{saves}{shots} \times 100$$

where the SAVES is number of goalkeepers saves in one match or total in championship, and SHOTS is total number of shots from different positions on the goal in one match or championship.

The second evaluation method presented and compared in this study is number of goalkeepers saves in one match or all championship (SAVES) divided with the number of minutes spent in the match (TIME). In this method finally result is average number of saves trough the one match (60 minutes). The goalkeeper's efficiency (Eg) has been calculated according to the formula:

$$Eg= \frac{saves}{time(h)}$$

In the third method goalkeeper saves were classified according to the distance they were performed from (6 m, 7 m for penalties, and 9 m and over for long range shots) or the specific position (wing shots performed by wings), fast breaks (shots performed in a clear fast break action) and breakthroughs (shots performed while in counterattack with 2-5 passes). In the last three championships there is one position more which is coded in official statistics, fast throw-off. Modern Handball introduced the "fast throw-off" concept, i.e. the play will be immediately restarted by the referees as soon as the executing team fulfils its requirements. Many teams leverage this rule to score easy goals before the opposition has time to form a stable defence line.

The sample of variables on basis of which the goalkeepers evaluation has been carried out comprises: 6m SAVE (6MS), 7m SAVE (7MS), 9m SAVE (9MS), WING SHOTS SAVE (WS), FAST BREAKS SAVE (FBS), BREAKTHROUGHS SAVE (BTS), FAST THROW OFF SAVE (FTOS). A specially devised continuous methodology has been applied in evaluating the save efficiency of goalkeepers who played more than 60 minutes in last European championship. This methodology comprises the goalkeeper's evaluation in defensive efficiency. The offensive efficiency of goalkeeper is not calculated in this study, it could comprise some elements such as goal scoring, assists, steals but they don't participate a lot in total goalkeepers' efficiency. The goalkeepers' efficiency (Eg) has been calculated according to the formula:

Eg=(6MS*0.76+7MS*0.78+9MS*0.56+WS*0.64+FBS*0.80+BTS*0.82+FTOS*0.78)/min

Coefficients of the relative significance (ponder) for each save or efficiency indicator have been suggested on the basis of the subjective assessment of the authors of this paper. The evaluation procedure has been carried out in several phases:

- For the development of the study, the arithmetic means for all the suggested variables have been calculated on the basis of the goalkeeper's statistics from the last ten European Championships (2000-2018). According to results it can be notice that all values from the same position or distance where the shots performed are very similar and almost the same. (*Table 1*). There is just one outlier that differs significantly from other data (Denmark 2014, 9MS=71%) and by inspecting all data on this championship it was concluded that is mistake made in writing official statistics. The highest goalkeepers' effectiveness was found from 9m distance (44,0%) and from the wing area (36,2%). In contrast, the lowest efficiency was found from breakthrough shots (17,6 %) and fast break shots (19,8%).
  According to the statistical analysis of the World Championship in 2009 (Alexandru et al., 2009), the less effective position for saving was in fast break (11.8%) and following that in the break-through position (25%).
- Introducing constant value 1.00 and subtract arithmetic mean for all suggested variables by reverse scaling gain the coefficients of the relative significance (weight ponder) for each variable.

In total, 47 matches during the event were analysed, the official statistical data provided by the EHF were used (available online at http://activities.eurohandball.com/analyses Webpage accessed on 20 Aug 2019).

Table1. Goalkeepers statistics in last ten European championships from different positions and coefficients of significance.

	MP	6MS	WS	9MS	7MS	FBS	BTS	FTOS	TOT
CRO 2000	38	22	40	45	24	19	17		
SWE 2002	50	30	37	46	26	19	16		34
SLO 2004	48	22	39	46	22	21	16		33
SUI 2006	47	20	38	44	23	20	18		32
NOR 2008	47	23	39	44	22	19	17		33
AUT 2010	47	21	34	44	22	22	21		32
SRB 2012	47	27	33	45	23	20	17		32
DEN 2014	47	24	34	71	20	20	22	21	31
POL 2016	47	27	35	39	22	19	14	25	30
CRO 2018	47	25	33	43	20	19	18	22	31
x		24,1	36,2	44,0	22,4	19,8	17,6	22,7	32
$1-\frac{x}{100}$		0,759	0,638	0,560	0,776	0,802	0,824	0,773	

Statistical analysis
Data were visually inspected and checked for normality using the Kolmogorov-Smirnov test. The data were normally distributed, and intergroup differences between goalkeeper's rankings in three assessment methods were determined with Friedman ANOVA analysis.

The goal of this research was to compared three methods for assessment goalkeeper's efficiency, standard method with save percentage for each goalkeeper, saves/time and the new method based on saves classified according to the distance and specific position of shots were made multiplied with coefficient of significance (6m,7m,9m, wing shots, fast breaks, breakthroughs, fast throw off).

RESULTS AND DISCUSSION

In 47 games European Championships in Croatia 16 teams from 4322 attempts scored 2562 goals, with a mean save percentage of 31% (1146 saves). Average goalkeepers' statistics was12 saves/teams/match. Best goalkeepers team come from Sweden with 36%, and the last come from Montenegro with 19%. Comparing 2016 and 2018 the shot's efficiency decreased via breakthrough by 10%, fast break by 7% and increased via 6m centre shots by 5%. At the goals distribution by positions we can find the following changes: by fast break goals increased by 4% and by breakthrough goals by 3% (EHF, 2018.)

In table no. 2 are presented all 28 goalkeepers from 16 countries, some countries are presented with two goalkeepers. Analysing the first column and save percentage (SP%), there can be see that first goalkeeper comes from Slovenia with 41 % effectiveness. There are effectiveness values between 37% and 41% that specialists in handball field consider as being very good (Calin, 2015). In the second method ranking position of the leader didn't change, Slovenian goalkeeper keep first position, but there is difference in second place where goalkeeper from the France fall down from second to ninth position. Spain goalkeeper fall down from

8th position to 18th position, and in opposite way Austrian goalkeeper from 23rd position in first method come to the 10th position in second method. One moment is also very important analysing this methods, Slovenian goalkeeper keeps very high ranks in all three methods, but he spent just 1.23 hours in all game's championships. In third new method there is one main difference from other two, Slovenian second goalkeeper come from 14th to first position. That's mean that in Slovenian goalkeeper range of saves was a lot "difficult" saves with higher coefficient of significance. And that is advantage and meaning of this study, to award goalkeepers which in range of their efficiency had more saves with "heavier" ponder weights. The goalkeepers are generally equally ranked in second and third methods comparing with first one.

Table 2. Comparison of three methods of evaluation.

Country	SP %	RANK	Save/time	Rang	NEW	RANG
SLO	41	1	17.89	1	11.14	2
FRA	37	2	14.91	9	9.303	9
SWE	36.23	3	16.23	3	10.21	4
DEN	36.02	4	16.01	5	9.921	7
SWE	35.38	5	15.33	6	10.15	6
MKD	35.18	6	16.74	2	10.92	3
BLR	34.97	7	16.03	4	10.17	5
NOR	34.43	8	14.96	8	9	13
ESP	34.43	8	12.62	18	7.64	20
GER	34.21	10	15.03	7	9.106	12
GER	34.12	11	12.65	17	7.761	18
CZE	33.77	12	13.97	12	9.328	8
CZE	33	13	14.09	11	9.137	10
ESP	32.4	14	11.55	21	7.528	21
ISL	31.53	15	13.16	16	8.341	17
SLO	31.53	15	13.83	14	11.47	1
SLO	31.48	17	11.33	23	7.305	24
BLR	31.25	18	13.89	13	8.662	15
MKD	30	19	12.19	19	7.652	19
CRO	29.67	20	11.70	20	7.479	23
AUT	28.2	21	13.25	15	8.887	14
FRA	28.12	22	11.92	20	8.545	16
AUT	27.58	23	14.55	10	9.12	11
DEN	27	24	10.35	26	6.516	26
SRB	25.82	25	11.39	23	7.505	22
HUN	25.74	26	10.61	25	6.952	25
MNE	21	27	7.74	27	4.97	27
CRO	20	28	6.91	28	4.173	28

Regarding the ranking position in all three methods, in the current study, Friedman ANOVA test do not significantly differ from each other ($\chi2 = 2.46$; $p = 0.29$).

Performance measurement is one of the main subjects of movement and training sciences. Game analysis methods used in this field have gradually improved.

Many of the most popular and original recent studies in this field have involved recording performance variables during or after competitions, and visual and written storage of these records in the computer environment. The measurement and assessment of performance play an important role in planning the training process and competition (Taborsky, 2011).

CONCLUSIONS

The aim of present study was to analyse save performance of the goalkeepers during the 2018 European Championships comparing existing and new methods. Comparison of these three methods indicate that goalkeeper effectiveness can be measured on different ways. New method, where the goalkeeper's saves has not equal ponder size is described in this study. Background of this new method is in different weight ponder for every shot from different distance or different throwing areas. Indeed, the Friedman ANOVA test did not establish statistically significant differences (p=0.29) in goalkeeping effectiveness between the different.

Methods, but 70 % is possibility that difference exist. Reason why differences do not exist between the methods can be in small differences between the ponder weights. Some ponder size are very close with final value to each other (e.g. 6MS=0.76; 7MS=0.78; FBS=0.80; BTS=0.82; FTOS=0.78). Therefore, it can be concluded, in the future researches coefficients of relative significance or ponder size get it by this methodology and these criteria need to be approved by experts or goalkeepers themselves.

Specifications
This research is based on the statistical results of the European Handball Federation site: www.activities.eurohandball.com/analyses

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