STUDIA UBB EDUCATIO ARTIS GYMN., LXIV, 3, 2019, pp. 5 - 16
(RECOMMENDED CITATION)
DOI:10.24193/subbeag.64(3).17

THE CONTRIBUTION OF THE EFFECTIVENESS OF HIGH-LEVEL GOALKEEPERS HANDBALL TO THE FINAL TEAM RANKING IN A CHAMPIONSHIP

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ABSTRACT. The role and contribution of each player in a game increases when all the players of the same team are trying with all their might for the same purpose, the win. One of the main contributors of this effort is the efficiency of the player who struggling under the post (goalkeeper) in order to infringe as little as possible compared with the post of the opponent goalkeeper. The purpose of this study was to compare and examine whether the somatometric characteristics and the effectiveness of the goalkeepers (GK) high level, contribute and how to achieve a winning result. All GK who declared and competed in the Croatian European Championship in 2018 were tested and compared, categorized based on the percentage of efficiency each of them presented in the championship in live-game throws and 7-meter throws. Their individual effectiveness was also evaluated by the final ranking of their teams in the championship. Statistical analysis of the data was performed with SPSS 24.0 statistical package and more specifically Crosstabs (Independence Check) command. The analysis showed that GK are classified in the category of "high" GK, in terms of age are older than other players. In terms of efficiency, it seemed that the GK whose teams were ranked first in the championship showed lower rankings than those whose teams were ranked lower. This leads us to conclude that the effectiveness of the GK does not determine or guarantee the performance of a team but just contributes to the good performance of each player. On the contrary, the excellent defense function on the one hand restricts the activity of the offensives, on the other hand, it facilitates the GK in the process of repulse of the throws.

Key words: *Handball, Goalkeepers, analysis, effectiveness.*

Introduction

Handball is a team sport played by two teams of seven (7) players using their hands to throw a ball, and is distinguished for its hard physical contacts

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and tackles. The objective of both teams is to score in the opposing team's goal, which is defended by the goalkeeper (GK). Although the GK does not come into contact with the opposition during the game, they need to possess certain physical characteristics and technical skills that differ from their teammates (Hermassi et al., 2017; Por & Buligan, 2003; Romero Novoa, 2012; Srhoj, Marinovic, & Rogulj, 2002).

The efficacy of the GK significantly affects the team performance, by inspiring confidence that the team's goal is guarded well, as well as the final result of a game (Bárcenas & y Román, 1991). Furthermore, the GK can contribute in the effectiveness of a good team and the competitiveness of a mediocre team. When the goalkeepers' decisions and actions are successful the team gets motivated (Steffen et al., 2017), whereas, if this not the case, the team's performance is worsened (Fuertes, Penas, & Martinez L.C., 2010; Meletakos & Bayios, 2010). According to Czerwinski (1997) the effectiveness of the GK can affect the team's performance up to 50%.

With the help of statistical analysis based on notational analysis or video-analysis, athletes can improve the effectiveness of them in-game actions by feedback and 'spying' on the opposition. They can also correct their mistakes and improve their communication by boosting the motivation and the efficacy of their players and of the team as a whole (Taylor et al., 2004).

The same means assess the performance of the GK, determining their effectiveness through the comparison of the oppositions' shots on goal versus the goalkeeper's saves (Bilge, 2012). So far, the majority of the studies investigate the goalkeepers' anthropometric measurements (Justin, Vuleta, Pori, Kajtna, & Pori, 2013) or their natural fitness (Hansen et al., 2017; Rousanoglou, Noutsos, & Bayios, 2014), with the intend to showcase a goalkeeper's ideal physique, in order to increase their effectiveness during a game. They also study important individual factors that determine a goalkeeper's effectiveness, e.g. space, the shot type and distance, κατάληξη μπάλας στην εστία or the shot result. Recent bibliography shows that teams that dominated international events, e.g. the Olympic Games, and world or European tournaments, possess leading tall goalkeepers, whose effectiveness hovers at about 35% if not above that (Fieseler et al., 2017).

Given that the effectiveness of a goalkeeper's defensive actions in game are defined by their anthropometric measurements, it would be of some value to study this correlation in high-level games.

Method

The study sample consists of 21 GKs who took part in 6 to 8 games in the final round of the 13th European Men's Tournament in Croatia in 2018. The GKs that played in fewer games were not considered. The sample is divided in

four (4) groups, according to their effectiveness against the total number of shots to their goal during the games. The first group includes the GKs who achieved a successful defensive attempt percentage over 35% (Fieseler et al., 2017). The second group includes GKs with a percentage range of 34% to 30%. The third group ranges from 29% to 20% and the fourth group included GKs with a successful defensive attempt percentage up to 19%. Additionally, the field shots and the 7-meter shots were studied separately.

In the study sample, the anthropometric measurements (height, body weight and body mass) were taken into consideration and compared to the overall effectiveness of defensive attempts, as well as the field shots and 7-meter shots.

The source of the data that were used for the study was the official website of the tournament, *https://cro2018.ehf-euro.com/statistics/top-player/#PlayerFrame#hblTopPlayer#TopPlayerContent#HBEC18M_TOPPLAYER_HBM400000_json#Lists.8* and pertained to all the GKs of the tournament.

Statistical analysis

For the data analysis, the frequency of throws against each GK was calculated, in relation to the throw result. The statistics package SPSS 24.0 was used and, in particular, the Crosstabs command (contingency tables). For the determination of statistically significant differences between the shot percentage and the effectiveness, the non-parametric method of x^2 test ($p<0.05$) was used.

Results

Table 1 shows the number of the GKs who, according to their effectiveness, were admitted to one of the four groups. The statistical analysis demonstrated a significant difference only in the percentage between the second and first groups ($x^2= 5.991$, $p<0.02$), as well as the second and fourth groups ($x^2= 11.375$, $p<0,001$), which signifies that few of the GKs are admitted into the high effectivity group.

Among the eight GKs who showed an effectiveness >35%, there were two GKs who took part in just two games, namely Kastelic from Slovenia and Sterbik from Spain, who were effective at a percentage of 41% and 42% respectively, but they weren't included in the comparisons between the groups because of their limited participation (2 games).

Table 1. Categorization of the GKs, based on the effectiveness of their defensive attempts

Groups	Effectiveness	N	Valid Percent	Cum. Percent
1.	>35 %	8	21.1	100.0
2.	30-34 %	14	36.8*	78.9
3.	20-29 %	10	26.3	42.1
4.	0-19 %	6	15.8	15.8

(* 2vs1, (x^2= 5.991, p<0.02) και 2 vs 4, (x^2= 11.375, p<0.001)).

Figure 1 shows the frequency of the games that each team played in the tournament. The teams that played six or more games were 12 and the GKs that were registered were 21 (Fig.2). Four teams played 8 games (participation percentage 33%), two played in 7 games (participation percentage 17%) and six teams played in 6 games (participation percentage 50%). The statistical analysis of the data did not indicate any significant difference in terms of teams' participation in the tournament.

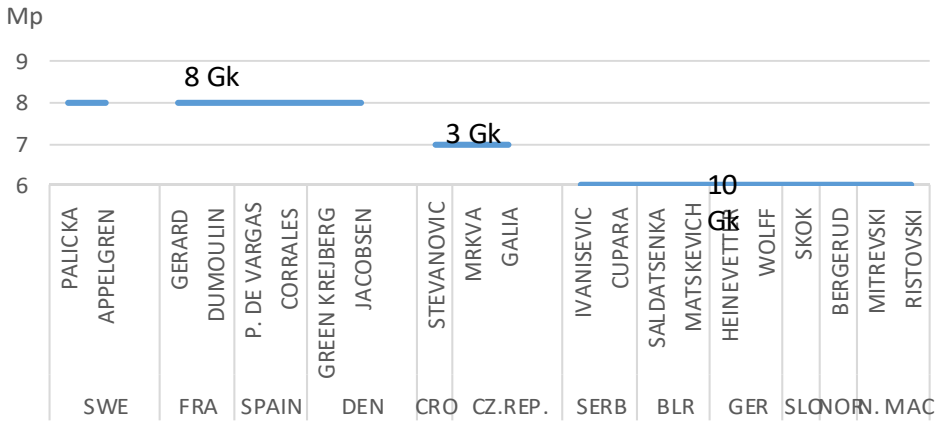

Fig. 1. Teams and GKs who were registered in more than 6 games.

Table 2 shows the average effectiveness of defensive attempts in relation to the body measurements of the GKs by group. Data analysis indicated a statistically significant difference only in the effectiveness between the averages of each group's defensive attempts (1st vs 4th (x^2=23.235, p<0.0001) and similarly, 2nd vs 4th (x^2=17.902 and p<0.0001) and 3th vs 4th (x^2=9.478, p<0.01)) and not in body measurements, age, height, and BMI between the groups.

Table 2. Averages of goalkeepers' effectiveness and body measurements among groups

Groups		M.O Eff/ness (%)	Years old	Height	Weight	BMI
1	**1**	37,1 *	30,1	192,5	97,4	27,5
2	**2**	32,7 #	29,1	195	99,3	25,8
3	**3**	24,7	30,9	195,1	97,1	25,5
4	**4**	8,5	27,5	195,5	102,7	26,9
	Mean of total G/K	**27,6**	**29,7**	**193,9**	**97,8**	**26,0**

(1 vs 4 (x^2= 23,235, p<0.0001) and 2 vs 4 (x^2= 17,902, p<0.0001) and 3 vs 4 (x^2=9.478, p<0.01).

Figure 4 shows the sum of the received shots by the GKs in 6-8 games (n=3620). Data analysis indicates that GKs from the 1st group received 1044 shots (28.8%), GKs from the 2nd received 1596 shots (44.1%), GKs from the 3rd received 766 shots (21.2%) and GKs from the 4th group received 214 shots (5.9%), (fig.4). These results demonstrate that the 2nd group received more shots than group 1 (x^2= 5.052, p<0.03), 3 (x^2= 11.923, p<0.001) and 4 (x^2= 38.913, p<0.0001). Furthermore, the 3rd group received significantly more shots than the 4th group (x^2=9.991, p<0.002) and the 1st group received significantly more shots than the 4th group (x^2=18.285, p<0.0001).

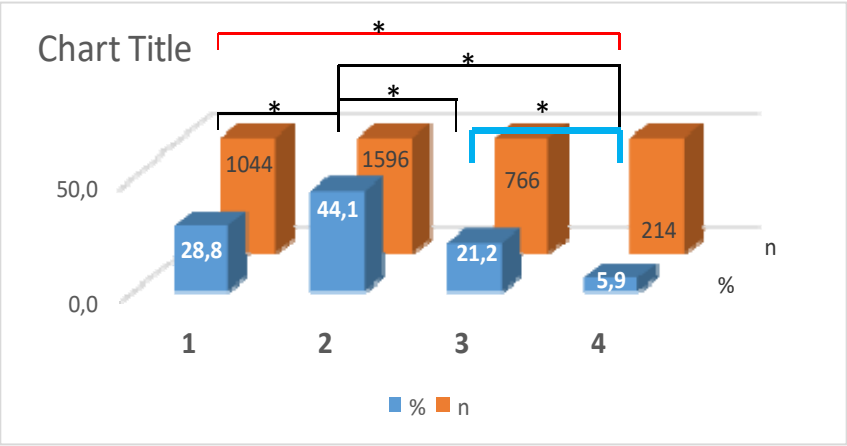

Figure 1. Total number of shots and percentages of shots by group of effectiveness of the goalkeepers

(* 2nd vs 1st (x^2= 5.052, p<0.03), 2nd vs 3th, (x^2=11.923, p<0.001), 2nd vs 4 (x^2= 38.913, p<0.0001), 3 vs 4, (x^2=9.991, p<0.002), 1 vs 4, (x^2=18.285, p<0.0001)).

A review of the total effectiveness between the groups of effectiveness of the goalkeepers, data analysis did not indicate significant differences in the 1st group (Fig. 2) or the 2nd group (Fig. 3).

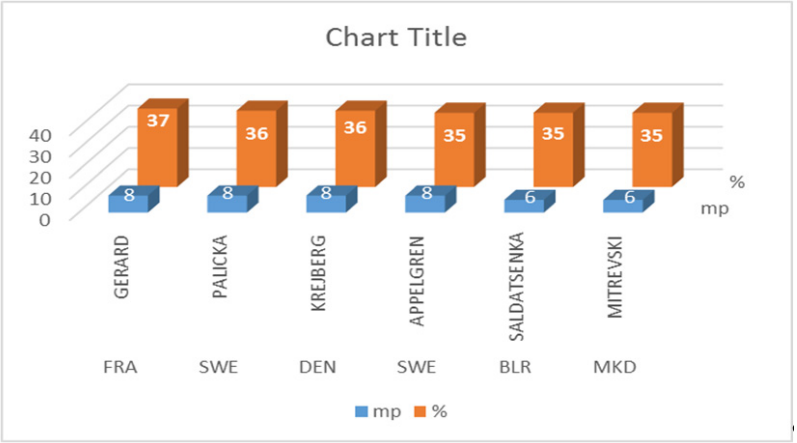

Figure 2. Effectiveness of 1st GK group

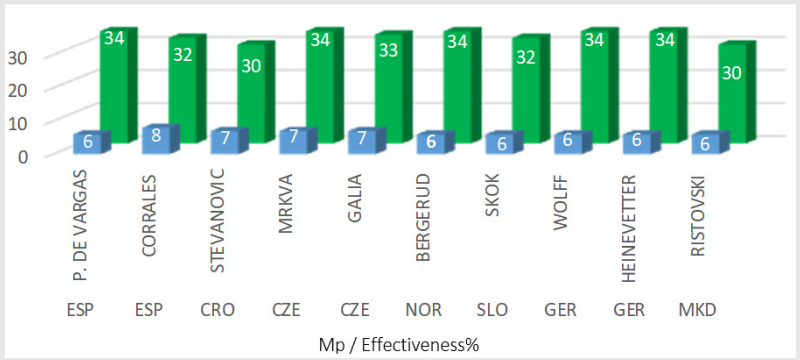

Figure 3. Effectiveness of 2nd GK group

An assessment of each goalkeeper's effectiveness in field shots and 7-meter shots, the statistical analysis showed differentiation of each goalkeeper's effectiveness, depending on shot type in the 1st and 2nd groups. In the 1st group, half of the goalkeepers (n=3) showed significant difference in effectiveness in field shots and 7-meter shots (x^2= 9.713, $p<0.002$, x^2= 7.867, $p<0.01$ and x^2= 5.254, $p<0.03$, respectively) and the rest (n=3) showed similar effectiveness between these two shot types (Fig. 4).

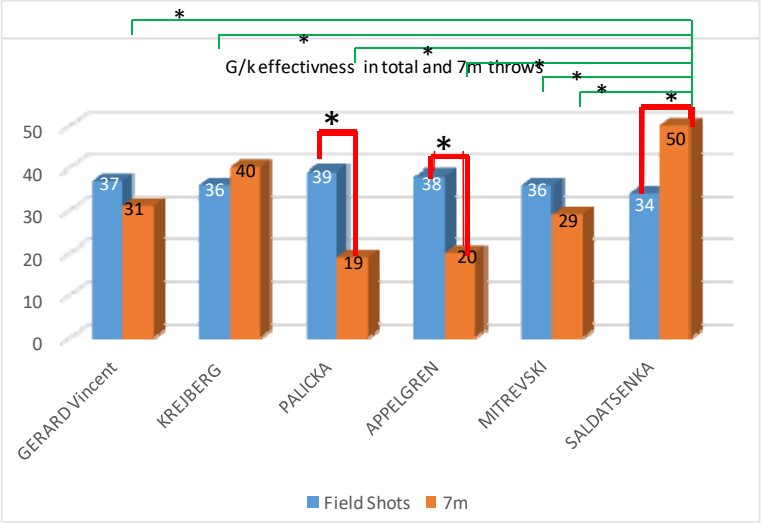

Figure 4. Percentages of effectiveness of each GK, against field shots and 7-meter shots.
Palicka, Appelgren, Saldatsenka, all field shots vs 7m.
(x^2 = 9.713, p<0.002, x^2= 7.867, p<0.01 and x^2= 5.254, p<0.03, respectively).
* Saldatsenka vs all in 7m., (x^2= 7,490, p< 0.0001).

Statistical analysis of the 2nd group indicated that most of the GKs (n=7) showed significant difference in effectiveness against field shots (x^2=3.977, p<0.05, x^2=5.222, p<0.03, x^2=5.913, p<0.02, x^2=6.650, p<0.01 and x^2=7.434, p<0.01, respectively). Analysis also showed that some GKs (n=4) were not effective at all against 7-meter shots, because they were substituted before the shot (Fig. 5).

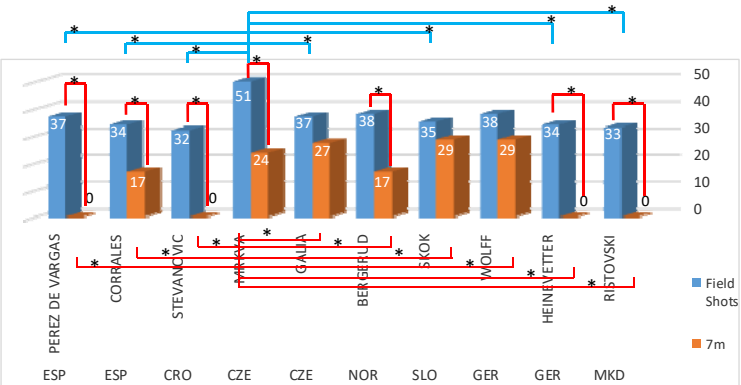

Figure 5. A Comparison of the goalkeepers' effectiveness against field shots vs 7-meter shots.

Discussion

According to the researchers (Espina-Agulló, Pérez-Turpin, Jiménez-Olmedo, Penichet-Tomás, & Pueo, 2016; Fuertes et al., 2010; Maroto-Izquierdo, García-López, & De Paz, 2017; Steffen et al., 2017; Meletakos & Bayios, 2010), the goalkeeper position has a key role in a team, with regard to its general performance, as well as in the final result of a game. In the 13th European Men's Handball Championship that took place in Croatia in 2018, the participating teams were 16, according to data from the EHF. However, the number of the goalkeepers that are registered in each team differs, which leads to a variable number of goalkeepers. In the 13th E.Ch., there were 38 goalkeeper registrations (Fig. 1). It was observed that some teams (n=6) registered 3 goalkeepers, whereas other teams (n=10) registered 2. In this study, the GKs' anthropometric measurements were analyzed and examined, pertaining to their effectiveness and the final placing of their teams.

The number of games in which the 38 GKs participated was relatively proportionate to their team's progression in the tournament. The statistical analysis showed that 14 GKs played in 8 games, 4 played in 7 games, 3 played in 6 and 5 games, 1 played in 4 games, 2 played in 3 games and 11 GKs played in 2 games.

A goalkeeper's performance (Hansen et al., 2017; Hasan, Rahaman, Cable, & Reilly, 2007; Murphy, Button, Chaouachi, & Behm, 2014*)* is related to their anthropometric measurements and their natural fitness, which affect their effectiveness and, therefore, play a crucial role in the choice of athletes, their effectiveness and their success in a sport discipline (Ziv & Lidor, 2009). Data processing indicated that the average GK who participated in the 13th European Men's Handball Championship measured 193.9cm in height and are characterized as "tall" goalkeepers (Justin et al., 2013). Almost all researchers mention that anthropometric measurements play a significant role in the performance of the players.

In regards to the age of the goalkeepers, the general average was 29.7 years, whereas the average of the goalkeepers that were categorized in the 1st group (successful defensive attempts >35%) was 30.1 years and the average of the 3rd group was 30.9 years. Game experience offsets the deteriorating physical skills of older players, explaining the high level of their effectiveness (Hamid, Hamid, Babak, Mahdi, & Ian, 2013; Justin et al., 2013; Karcher & Buchheit, 2014; Michalsik, Madsen, & Aagaard, 2015).

The average weight was 97.8kg and the average BMI was 26.0 kg/m^2 (Table 2). There are similar results in the study of Hamid et al. (2013), which mentions that in the 2013 World Men's Handball Championship the average GK

height was 191.59cm, the weight 95.7kg and the BMI 25.59 kg/m^2. Massuca et al. (2015) studied the body measurements of 24 handball goalkeepers who played in the Portuguese Championship and mentions an average height of 183.7cm, weight 86.8kg and BMI 25.7 kg/m^2, which diverge from the average of high-level GKs.οποίος αναφέρει ότι στο παγκόσμιο πρωτάθλημα ανδρών το 2013 ο μ.ο. ύψους στους Τ/Φ ήταν 191.59 cm, βάρους 95.7kg. και, BMI 25.59 kg/m^2. Michalsik et al. (2015), studying players from the Danish Premier Handball League, mentions an average GK age of 30.2 years, height 191.8cm, weight 94.2kg and BMI 25.5 kg/m^2, which correlates with the data that characterize high-level handball goalkeepers.

The current data analysis showed no differences in regards to the averages of the anthropometric measurements and ages of the goalkeepers, in comparison to observations of other similar studies.

An assessment of the categorization of the goalkeepers according to their effectiveness indicated significant differences between groups. More specifically, the 1st group showed significant difference in shots received compared to the 2nd, which cannot be accounted for, since the 1st GK group participated in more games than the second. The difference between the 1st and 2nd groups compared to the 3rd and 4th groups can be summarized to the fact that the 3rd and 4th groups participated in fewer games against teams of equal or lesser ability (Hongyou, Miguel A., & Lago-Peñas, 2015).

A review of the goalkeepers that belong to the 1st group (highest effectiveness) shows the absence of the GKs of Spain (Perez De Vargas, 35% and Corrales, 32%), the team which was the champion of the 2018 E.Ch in Croatia. On the other hand, Saldatsenka, the goalkeeper of Belarus who participated in 6 games, received the most shots for a percentage of effectiveness of 35% even as his team finished 10th, which was higher than the GKs of Spain (1st) and equal to Applegren of Sweden (2nd), who also had a percentage of effectiveness of 35% and the second most shots received.

This fact leads to the conclusion that a goalkeeper's effectiveness contributes to a team's progression as much as the other players' performance but it does not determine or secure it. Contrarily, good defense limits the offensive activity of the opposition and reduces the offensive threat, leading to less defensive attempts from the GK, helping them save shots, since the shots are made under pressure.

According to the study of Balint (2013), defense in modern handball is the cornerstone of teams that want to dominate major tournaments. What this means is that defense is established through continuous and systematic work by all the players, which can lead to a particularly taxing, physically and mentally,

training system. Communication and cooperation between the defense and the goalkeeper is widely recognized as being the factor that, along with technical-tactical and mental training, as well as good natural fitness, can determine the team's performance, particularly in difficult games. Technical-tactical and mental training is the deciding factor that forges a commanding and high-level defensive player in handball (Balint, 2013).

Furthermore, a very important characteristic of handball is that defense primarily aims to stop attackers from reaching the goal and to reduce the threat for the goalkeeper. The rapid concentration of defense in the various offensive formations and the adaptation of them, has the effect of increasing its immediate effectiveness, which most likely affects the final result of a game (Yiannakos, 2016).

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