

**Leuciuc Florin
Valentin¹**

**LONGITUDINAL STUDY ON THE
EFFECTIVENESS OF THE GAME ACTIONS
IN MEN'S HANDBALL TOP COMPETITIONS
(1998-2016)**

**LONGITUDINALNA ŠTUDIJA O
UČINKOVITOSTI AKCIJ V IGRI NA
VRHUNSKIH TEKMOVANJIH MOŠKEGA
ROKOMETA (1998–2016)**

ABSTRACT

To achieve performance in top competitions, a very good training level is needed, but there are also other factors contributing to the final result: efficiency in attack and defence actions, home advantage, penalties, tactical plans, ability to collaborate with teammates, anthropometric parameters, and personal specific skills. The aim of the study is to determine the efficiency of the game's actions in men's handball top competitions and its influence on team's performance. This study may indicate the trends of men's handball with consequences both in the training process and performance in high level competitions. Statistical analysis reveals the differences between top teams and all the competing teams ($p < 0.01$; $p < 0.001$). There is also a correlation between these data for all analysed competitions of this research. According to the findings of this research, the minimum requirements of the efficiency in attack and defence for men's handball top competitions must be achieved by all teams in order to obtain performance and a better position in the final standing. For the teams that are below average, in terms of efficiency, there is needed to use practical situations more often in training, situations met in matches to be resolved and to focus on increasing the shots' efficiency. Workout is also needed to be done in terms of fatigue and also to participate in friendly competitions with the same format as the official ones. According to these findings, the efficiency of the game's actions is the main factor contributing to the achievement of the performance in men's handball top competitions.

Keywords: efficiency, statistics, performance, indicators

¹*Ștefan cel Mare University of Suceava*

Corresponding author:

Leuciuc Florin Valentin

Ștefan cel Mare University of Suceava

E-mail: florinl@usv.ro, phone +40746852974

IZVLEČEK

Da bi na vrhunskih tekmovanjih dosegli uspešnost, mora biti trening na visoki ravni, vendar pa obstajajo tudi drugi dejavniki, ki prispevajo h končnemu rezultatu: učinkovitost v akcijah napada in obrambe, prednost domačega igrišča, prekrški, taktični načrti, sposobnost sodelovanja s soigralci, antropometrični parametri in specifične osebne veščine. Namen raziskave je bil ugotoviti učinkovitost akcij v igri na vrhunskih tekmah moškega rokometu ter njen vpliv na uspešnost ekipe. Raziskava prikazuje trende v moškem rokometu, ki vplivajo tako na trenajni proces kot na uspešnost na vrhunskih tekmovanjih. Statistična analiza je pokazala razlike med najboljšimi ekipami in vsemi tekmovalnimi ekipami ($p < 0,01$; $p < 0,001$). Ti podatki tudi korelirajo s podatki vseh analiziranih tekmovanj v tej raziskavi. V skladu z ugotovitvami te raziskave morajo minimalne zahteve glede učinkovitosti v akcijah napada in obrambe na vrhunskih tekmah moškega rokometu dosegati vse ekipe, da so lahko obravnavane kot uspešne in se bolje uvrstijo na končni lestvici. Za ekipe, ki so podpovprečno učinkovite, je treba na treningih pogosteje uporabljati praktične situacije in reševati situacije, ki so se zgodile na tekmah, ter se osredotočiti na povečanje učinkovitosti strelav na gol. Prav tako je treba izvajati telesno vadbo, da se zmanjša utrujenost, ter sodelovati na prijateljskih tekmovanjih, ki so enakega formata kot uradna. V skladu z izsledki raziskave je učinkovitost akcij v igri glavni dejavnik, ki prispeva k uspešnosti na vrhunskih tekmah moškega rokometu.

Ključne besede: učinkovitost, statistika, uspešnost, kazalniki

INTRODUCTION

To achieve performance in handball top competitions a very good training level (physical, technical, tactical, and psychological) is needed (Yasar & Murat B., 2005; Cardinale, Whiteley, Hosny, & Popovic, 2017), but there are also another factors contributing to the final result: efficiency in attack and defence actions; team timeout (Gomes, Volossovitch, & Ferreira, 2014; Gutierrez-Aguilar, Montoya-Fernandez, Fernandez-Romero, & Saavedra-Garcia, 2016; Prieto, Gomez, Volossovitch, & Sampaio, 2016); home advantage (Aguilar, Garcia, & Romero, 2015); penalties (yellow card, 2-min exclusion, red card, blue card) (Milanovic, Vuleta, & Jerak, 2017); tactical plans, ability to collaborate with teammates, anthropometric parameters, personal specific skills (Taborski, 2008; Meletakos, Vagenas, & Bayios, 2011).

This study is manly based to determine the influence of the efficiency in attack and defence actions in men's handball top competitions.

There are studies regarding the situational efficiency focused on the shots' efficiency and team's efficiency (Apitzs & Liu, 1997; Taborsky, 2008), on the connection with the playing positions (Gruic, Vuleta, & Milanovic, 2006; Ohnjec, Vuleta, Milanovic, & Gruic, 2008), on the relation concerning the shooting areas (Rogulj, 2000, Pokrajac, 2008), the influence of the tactics on shots' efficiency (Srhoj, Rogulj, & Katic, 2001; Rogulj, Srhoj, & Srhoj, 2004; Rogulj & Srhoj, 2009), there is also a comprehensive one combining different situations of shots' efficiency (Foretic & Papic, 2013).

The winning teams significantly scored higher in the following situations: fast break, 9m-line, 6m-line in offence and blocked more shots in defence; the defeated teams scored higher in the breakthrough and from 9m-line. These differences, statistically obtained between the winning and the defeated teams, decisively contributed to the final outcome (Vuleta, Rogulj, & Milanovic, 2017).

The analysis of the situational efficiency indicators of shots showed no statistical significant differences among top teams and we can conclude that there are very few differences in terms of efficiency of the best teams (Uzelac-Sciran, 2017); also men's teams recorded a significant higher number of unsuccessful shots from 6 meters and 2-min penalties (Milanovic, Vuleta, & Jerak, 2017).

There are important differences among the first eight teams (almost all European) of top handball men's competitions (European Championships, World Championships, and Olympic Games) in terms of efficiency, especially for fast break, 6m-line and back court shots (Bilge, 2013).

In this study we quantified the data collected from the most important competitions of the handball players of the national team: European Championships, World Championships and Olympic Games.

The format of these three competitions has changed both the number of the competing teams and the number of matches. Nowadays, 16 teams participated at the final tournament of the European Championships (E.C.), 24 teams participated at World Championships (W.C.) and 12 teams at the Olympic Games (O.G.).

The first edition of E.C. was held in 1994, being now organized every two years. Nowadays W.C. are organized every two years, the first edition taking place in 1938 (indoor handball); the first

presence at O.G. was held in 1936 and since 1972 it has remained constantly in the Olympic program, the competition taking place every 4 years. The teams go through qualifiers in order to be present in the final phase.

MATERIAL AND METHODS

The aim of the study is to determine the efficiency of the game's actions in men's handball top competitions and its influence on team's performance.

This study may indicate the trends in men's handball with consequences both in the training process and performance in high level competitions.

The main methods used in this study were the bibliographic and statistics. The bibliographic method was used by studying the analyzes conducted after competitions. The statistical method was used to process the data supplied by the IHF and EHF.

The descriptive statistics were calculated based on the collected data, while ANOVA and correlation were used for the purpose of determining the differences.

RESULTS

The game's actions providing the statistical analysis are: shots efficiency (6m, wings, 9m, 7m, fast break and overall), goalkeepers' efficiency, interception and blocked shots.

For these actions the analysis was performed as follows: for all the competing teams and the first 4 teams for each competition (table 1).

Table 1. Game actions efficiency averages for teams participating at European Championships, World Championships and Olympic Games (1998-2016)

| Statistical parameters / Game actions | Shots efficiency (%) | | | 7m shots efficiency (%) | Fast break efficiency (%) | Shots efficiency (%) | Goalkeepers' efficiency (%) | Interceptions (no.) | Blocked shots (no.) |
|---------------------------------------|----------------------|------------|------------|-------------------------|---------------------------|----------------------|-----------------------------|---------------------|---------------------|
| | 6m | wing | backcourt | | | | | | |
| European Championships | | | | | | | | | |
| X±SD (1-16) | 71.50±3.67 | 54.79±3.18 | 39.34±2.14 | 71.88±1.97 | 72.90±4.70 | 55.04±1.67 | 32.29±0.89 | 22.30±4.62 | 19.53±2.68 |
| X±SD (1-4) | 70.00±5.77 | 58.02±2.65 | 41.58±4.96 | 73.31±4.57 | 73.15±6.29 | 57.38±2.84 | 34.89±1.68 | 30.61±6.88 | 30.44±6.51 |
| World Championships | | | | | | | | | |
| X±SD (1-24) | 65.39±5.40 | 54.71±3.40 | 38.64±1.20 | 72.25±0.72 | 74.78±2.29 | 55.33±1.43 | 32.38±1.72 | 40.07±14.56 | 22.55±4.43 |
| X±SD (1-4) | 69.50±4.00 | 61.00±2.92 | 43.71±2.72 | 77.79±4.23 | 78.96±2.14 | 60.88±1.18 | 34.17±1.94 | 58.21±26.95 | 36.21±5.14 |
| Olympic Games | | | | | | | | | |
| X±SD (1-12) | 66.50±3.45 | 57.50±5.87 | 39.00±2.18 | 74.69±3.73 | 74.38±3.69 | 55.83±3.14 | 31.75±2.62 | 28.79±10.85 | 21.19±5.17 |
| X±SD (1-4) | 69.88±3.82 | 60.80±5.03 | 41.44±5.15 | 79.00±3.79 | 75.50±6.66 | 59.75±3.65 | 34.04±3.59 | 35.69±13.84 | 32.00±7.46 |

X – mean, SD – standard deviation.

The statistical analysis was made by using ANOVA test and Pearson correlation to see the differences among the first 4 teams' indicators and all the competing teams (table 2).

Table 2. Top 4 teams versus all participating teams' analysis (ANOVA and correlation)

| Indicators / Statistical parameters | World Championships (top 4 vs. 24 teams) | | | European Championships (top 4 vs. 16 teams) | | | Olympic Games (top 4 vs. 12 teams) | | |
|-------------------------------------|---|---------|-------------|--|---------|-------------|---------------------------------------|------|-------------|
| | F(1,10) | p | Correlation | F(1,16) | p | Correlation | F(1,6) | p | Correlation |
| 6m shots (%) | 2.244 | .165 | 0.963 | 0.385 | .545 | 0.716 | 1.021 | .351 | 0.709 |
| Wing shots (%) | 11.831 | .006 | 0.960 | 4.869 | .045* | 0.477 | 0.735 | .424 | 0.998 |
| Backcourt shots (%) | 17.399 | .002** | 0.408 | 1.368 | .262 | 0.834 | 0.760 | .417 | 0.825 |
| 7m shots (%) | 10.048 | .010** | -0.663 | 0.746 | .400 | 0.524 | 0.087 | .778 | 0.820 |
| Fast break (%) | 10.655 | .009** | 0.572 | 12.477 | .003** | 0.593 | 2.633 | .156 | 0.782 |
| Overall shots (%) | 53.850 | .001*** | 0.175 | 4.550 | .049* | 0.712 | 2.652 | .155 | 0.978 |
| Goalkeepers' efficiency (%) | 2.841 | .123 | -0.461 | 16.715 | .001*** | 0.767 | 0.889 | .382 | 0.911 |
| Interceptions (no.) | 2.103 | .178 | 0.961 | 9.055 | .008** | 0.848 | 0.700 | .435 | 0.976 |
| Blocked shots (no.) | 24.335 | .001*** | 0.524 | 21.658 | .001*** | 0.787 | 5.241 | .062 | 0.981 |

Asterisk indicate significant differences (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$); F - MS factor/MS residual; p - statistical significance.

The analysis (ANOVA, Pearson correlation) of the same indicator at each of the 3 competitions is showed in table 3.

Table 3. Top 4 teams and all participating teams' indicators analysis (ANOVA)

| Indicators / Statistical parameters | Top 4 | | All teams | |
|-------------------------------------|---------|-------|-----------|-------|
| | F(2,16) | p | F(2,16) | p |
| 6m shots (%) | 0.018 | 0.982 | 3.617 | 0.052 |
| Wing shots (%) | 1.684 | 0.219 | 0.757 | 0.486 |
| Backcourt shots (%) | 0.494 | 0.620 | 0.234 | 0.794 |
| 7m shots (%) | 1.492 | 0.255 | 1.924 | 0.178 |
| Fast break (%) | 3.362 | 0.060 | 0.527 | 0.601 |
| Overall shots (%) | 3.373 | 0.060 | 0.227 | 0.799 |
| Goalkeepers' efficiency (%) | 0.612 | 0.555 | 0.259 | 0.775 |
| Interceptions (no.) | 5.425 | 0.016 | 6.319 | 0.009 |
| Blocked shots (no.) | 1.960 | 0.173 | 1.197 | 0.328 |

F - MS factor/MS residual; p - statistical significance.

DISCUSSION AND CONCLUSIONS

Although the number of the competing teams is different (24 – W.C., 16 – E.C., 12 – O.G.) for the first 4 ranked teams, with 3 exceptions (7m shots, fast break efficiency, interceptions), for other 6 indicators the average values were closed and this could be explained in the way that the

best teams usually excelled in all the indicators in term of efficiency or had some strong points in certain indicators (Gutierrez & Ruiz, 2013; Espina-Agullo, Perez-Turpin, Jimenez-Olmedo, Penichet-Tomas, & Pueo, 2016). When there are analysed indicators for all teams involved in each of these 3 major men's handball competitions, for 7 indicators the average values were closed (wing shots, backcourt shots, 7m shots, overall shots, fast break efficiency, goalkeepers' efficiency, blocked shots) and for only 2 there were registered differences and this is in trend with what other researches confirm (Rogulj, 2000; Gruic, Vuleta, & Milanovic, 2006; Pokrajac, 2008; Meletakos, Vagenas, & Bayios, 2011; Bilge M., 2013) (table 2).

An analysis (ANOVA and correlation) between the first 4 ranked teams and all the competing teams at W.C. reveals 6 (wing shots, backcourt shots, 7m shots, fast break, overall shots, blocked shots) out of 9 indicators showing a significant difference for ANOVA test and 5 (6m shots, wing shots, 7m shots, interceptions) out of 9 indicators showing a strong or very strong correlation. The first 4 teams ranked at W.C. are usually European teams, for the analysed period being only 2 exceptions (2005 – Tunisia 4th place, 2015 – Qatar – 2nd place; both countries were the organisers) (Aguilar, Garcia, & Romero, 2015; Gomez, Lago-Penas, Viano, & Gonzalez-Garcia, 2014; Leuciuc & Pricop, 2015a). Of the total of 24 participating teams, 14 are from Europe (and almost all ranked in the first 16 places), 4 from Asia, 3 from America and 3 from Africa. For E.C. there were also 6 (wing shots, fast break, overall shots, goalkeepers' efficiency, interceptions, blocked shots) out of 9 indicators showing a significant difference for ANOVA test and 5 (6m shots, backcourt shots, overall shots, goalkeepers' efficiency, interceptions) out of 9 indicators showing a strong or very strong correlation (Meletakos, Vagenas, & Bayios, 2011; Bilge, 2013; Leuciuc & Pricop, 2015b) (table 3). At O.G. there was obtained a strong or very strong correlation for all indicators but at this competition, only 12 teams participated (7 from Europe, 2 each from America and Africa, 1 from Asia) and in the last editions, only European teams were ranked in the first 4 places (Taborski, 2008; Leuciuc, 2017) (table 2).

The analysis of the same indicator at each of the 3 competitions, for the first 4 teams and all competing teams, did not show any significant differences meaning that the analyzed data indicated the same trend in terms of efficiency (table 3) (Bilge, 2013). For these 9 analyzed indicators in this study, 6 refer to offensive actions and 3 to defensive actions.

The results of the research were compared with the recommendations of the scientific literature on the minimum efficiency of game actions and based on benchmarks (Taborsky, 2001) appearing that backcourt' shots requirements are met only in teams ranked in the first half; when the average covers all the participating teams, the values are below the minimum recommended. In some cases, the situation is similar regarding the wings' shots; the teams of the first half exceeded the maximum recommended level. For 6m and fast break shots, the requirements are minimal, but there are situations when the efficiency exceeded the maximum mark. Regarding the 7m shots, only for 3 of the 9 situations there was analysed the fulfillment of the minimum requirement, and all 9 values of goalkeepers are under recommendations. According to the results of other studies treating the efficiency of game's actions, it is needed to reconsider the margins of efficiency for certain indicators (Yasar & Murat, 2005; Gruic, Vuleta, & Milanovic, 2006; Taborski, 2008; Espina-Agullo, Perez-Turpin, Jimenez-Olmedo, Penichet-Tomas, & Pueo, 2016; Vuleta, Rogulj, & Milanovic, 2017).

6m shots increased by 5% as the minimum level in all categories exceeded the upper margin, because the analysis of offensive actions in three consecutive Men's World Championships

(2005, 2007 and 2009) showed the same: an increasing trend of the efficiency for 6-meter shots (Meletakos, Vagenas, & Bayios, 2011; Leuciuc & Pricop, 2015a).

According to the findings of this research, the minimum requirements of efficiency in attack and defence for men's handball top competitions are: 6m shots - 65%, wing shots - 55%, backcourt shots – 40%, 7m shots - 75%, fast break - 70%, overall shots – 60%, goalkeepers' – 30%.

To achieve performance a very good efficiency is needed for all indicators of both offence and defence, because there is a direct and strong correlation between the level of efficiency and the place in the final ranking (Gutierrez, Ruiz, 2013).

According to these findings, the efficiency of the game's actions is the main factor contributing to the achievement of the performance in men's handball top competitions, together with physical fitness, personal specific skills, experience, ability to collaborate with teammates, home advantage, and team timeout. The vectorial action of these factors is decisive for performance and a better position in the final standing.

The number of the matches at each edition of these 3 competitions was different, but an increasing trend is observed, namely the shooting attempt and the number of scored goals.

For the teams that are below average, in terms of efficiency, there is needed to use more often practical situations in training, situations met in matches to be resolved, and to focus on increasing the shots' efficiency. Workout is also needed to be done in terms of fatigue and also to participate at friendly competitions with the same format as the official ones. The degree of fulfillments of these requirements should be visible at the following competitions, which will later require a reassessment to check on the monitored indicators.

These findings provide valuable information for handball coaches (covering a period of 18 years - 1998-2016), helping them to design their strategic and tactical plans.

REFERENCES

- Aguilar, O.G., Garcia, M.S., & Romero, J.J.F. (2015). Effect of being the organizer of a handball world championship in team performance. *Revista Internacional de Medicina y Ciencias de la Actividad Fisica y del Deporte*, 15 (57), 139-150.
- Apitzs, E. & Liu, W.H. (1997). Correlation between field dependance-independance and handball shooting by Swedish national male players. *Perceptual and Motor Skills*, 84, 1395-1398.
- Bilge, M. (2013). Game Analysis of Olympic, World and European Championships in Men's Handball. *Journal of Human Kinetics*, 35, 109-118.
- Cardinale, M., Whiteley, R., Hosny, A.A., & Popovic, N. (2017). Activity Profiles and Positional Differences of Handball Players During the World Championships in Qatar 2015. *International Journal of Sports Physiology and Performance*, 12(7), 908-915.
- Espina-Agullo, J.J., Perez-Turpin, J.A., Jimenez-Olmedo, J.M., Penichet-Tomas, A., & Pueo, B., 2016, Effectiveness of Male Handball Goalkeepers: A historical overview 1982-2012. *International Journal of Performance Analysis in Sport*, 16(1), 143-156.
- Foretic, N., & Papić, V. (2013). Empirical model for evaluating situational efficiency in top level handball. *International Journal of Performance Analysis in Sport*, 13, 275-293.
- Gomes, F., Volossovitch, A., & Ferreira, A.P. (2014). Team timeout calling in handball, *International Journal of Performance Analysis in Sport*, 14(1), 98-110.

- Gomez, M.A., Lago-Penas, C., Viano, J., & Gonzalez-Garcia, I. (2014). Effects of game location, team quality and final outcome on game-related statistics in professional handball close games. *Kinesiology*, 46(2), 249-257.
- Gruic, I., Vuleta, D. & Milanovic, D. (2006). Performance indicators of teams at the 2003 men's world handball championship in Portugal. *Kinesiology*, 38(2), 164-175.
- Gutierrez, O., & Ruiz, J.L. (2013). Game Performance Versus Competitive Performance in the World Championship of Handball 2011. *Journal of Human Kinetics*, volume 36, p.137-147
- Gutierrez-Aguilar, O., Montoya-Fernandez, M., Fernandez-Romero, J.J., & Saavedra-Garcia, M.A. (2016). Analysis of time-out use in handball and its influence on the game performance, *International Journal of Performance Analysis in Sport*, 16(1), 1-11.
- Leuciuc, F., & Pricop, G. (2015a). Longitudinal study on the effectiveness of the game actions at the World Men's Handball Championship seniors (2005-2015), *The Annals of "Dunarea De Jos" University of Galati, Fascicle XV, 2*, 27-32.
- Leuciuc, F., & Pricop, G. (2015b). Longitudinal study on the effectiveness of the game actions at the European men's handball championship seniors (1998-2014), *The Annals of "Dunarea De Jos" University of Galati, Fascicle XV, 1*, 58-66.
- Leuciuc, F. (2017). Longitudinal study on the effectiveness of game actions during the Olympic Games men's handball (2004-2016). *Journal of Physical Education and Sport*, 17(2), 717-721.
- 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.
- Milanovic, D., Vuleta, D., & Jerak, T. (2017). Competition performance of elite male and female handball teams: features and differences, *8th International Scientific Conference On Kinesiology, MAY 10-14, 2017*, 376-379.
- Ohnjec, K., Vuleta, D., Milanovic, D. & Gruic, I. (2008). Performance indicators of teams at the 2003 world handball championship for women in Croatia. *Kinesiology*, 40(1), 69-79.
- Pokrajac, B. (2008). EHF Men's Euro 2008 – Analysis, discussion, comparison, tendencies in modern handball. *EHF WEeb Periodical*, 1-15.
- Prieto, J., Gomez, M.A., Volossovitch, A., & Sampaio, J. (2016). Effects of team timeouts on the teams' scoring performance in elite handball close games. *Kinesiology*, 48(1), 115-123.
- Rogulj, N. (2000). Differences in situation-related indicators of handball game in relation to the achieved competitive results of the teams at 1999 World Championship in Egypt. *Kinesiology*, 32(2), 63-74.
- Rogulj, N., Srhoj, V. & Srhoj, Lj. (2004). The contribution of collective attack tactics in differentiating handball score efficiency. *Collegium Antropologicum*, 28(2), 739-746.
- Rogulj, N. & Srhoj, V. (2009). Influence of the collective attack tactics on handball match outcome. *Physical culture*, 37, 15-20.
- Srhoj, V., Rogulj, N. & Katic, R. (2001). Influence of the attack end conduction on match result in handball. *Collegium Antropologicum*, 25(2), 611-617.
- Taborsky, F. (2001). Game performance in handball. *EHF Web Periodical*, 26.
- Taborsky, F. (2008). Cumulative indicators of team playing performance in handball (Olympic Games Tournaments 2008). *EHF Web Periodical*, 1-10.
- Uzelac-Sciran, T. (2017). Indicators of situational efficiency of PPD Zagreb and MVM Veszprem handball players in regular 2015. / 2016. SEHA league season. *8th International Scientific Conference on Kinesiology, MAY 10-14, 2017*, 423-427.

Vuleta, D., Rogulj, N., & Milanovic, D., 2017, Differences between winning and defeated handball teams in competition performance indicators. *8th International Scientific Conference on Kinesiology, MAY 10-14, 2017*, 432-435

Yasar, S., & Murat, B. (2005). The comparison of the last olympic, world and european men handball championships and the current developments in world handball. *EHF Web Periodical*,