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THE IMPACT OF QUALITY WATERPOLO SCISSORS PERFORMANCE ON THE INTENSITY OF BALL KICK OUT UNDER THE CONDITION OF HOMEOSTASIS DEROGATION

ABSTRACT

The sample of 25 waterpolo players of different quality level was subdued to the following estimations: the importance of "scissors" quality on the intensity of ball kick out under the optimal actual muscle condition, as well as after the local fatigue and the examinee maximal power estimation during the shot simulation by classical dynamometry application. The examinee technique was estimated by the group of experts evaluating them 5 to 10. On the basis of those grades, the sample was divided into three quality groups: masters (4 examinees), average waterpolo players (16 examinees) and beginners (5 examinees).

Statistical analysis result access completely confirmed the assumption that best quality players suffered from less consequences caused by fatigue. Significance levels were lower than the theoretical limit (Sig.<,05) only in subsamples of technically average and least successful waterpolo players, while there were no differences in the group of the best quality ones. Although the best quality group accuracy decerased approximately almost for a fifth (about 19%), that change was not enough to be determined as statistically significant. In groups of average players and beginners, relative decrease of the throw duration was even lower than in the best quality group (15,99% in the middle and 18,4% in the lowest quality group), but the change was determined to be statistically significant for its significantly lower elementary values (gained in pre-test).

Key words: waterpolo players, technique, power, grade

INTRODUCTION

Classifying the total sample into three subsamples – masters, average waterpolo players and waterpolo beginners was completed on the basis of key variable – expert evaluation of their watrepolo technique. Maximal anticipated evaluation was 10 and minimal 5. According to six anticipated grades (5, 6, 7, 8, 9 and 10) examinees were classified into three evaluational categories (Table and Figure X.1-1). However, none of the examinees got 10, so only four of them who got nine were classified into the best group, marked as masters of waterpolo technique. Those who got 7 and 8 were marked as the examinees with the average technique level and the ones with grades 5 and 6 were marked as waterpolo beginners (Table and Figure X.1-2). Among 25 examinees majority was marked as average (16 examinees or 64%), and significantly less number with minimal and maximal evaluational continuum (16% masters and 20% beginners). According to distribution of expert evaluation of 25 examinees' waterpolo technique (Table and Figure X.1-2), to the average values determined on a level of complete sample and subsamples (Table and Figure X.1-3), the conclusion was that the quality of waterpolo players included in this examination was not of a high level. Considering that the examinees with the grade seven dominated the sample (lowest average limit), the total average grade was slightly higher than seven. From methodological point of view, the most important thing was that three strata separated in the sample which enabled spotting certain validities in detection of some variabilities.

Former researches

The best and the lowest quality group both had eight examinees with the absolute frequencies below the lower limit, which is, according to modern statistic theorists (Conover, 1980; Baliley, 1981; Vincent, 1995; Perić, 2006), considered a minimum necessary for parametric statistics application. Therefore, some adequate non-parametric procedures had to be used while actualizing discriminative and causal analyses. Avoiding larger errors caused by the small number of samples and application of non-parametric statistics led to neglecting possible parasitic influence of poor cognition about variable theoretic schedules.

Outstanding watrepolo players throw the ball with speed from 58 to 88 km/h (Natunene, 1995) while shooting straight to the goal. The research showed that players at international level throw the ball faster than players at regional level. Numerous biomechanic and kinematic analyses of waterpolo shot showed movement tasks which affect the ball speed in a great deal. Those are: body rotation (29% benefit from the throwing speed), inner or horizontal rotations of forearm abductor (31%), elbow extensor (22%) and clamp flexion (8%). During accomplishing the maximal ball speed two most often techniques include body rotation. Elbow and arm clamps are in phases of flexion, extension or inner forearm rotation which depends of the adequate ball control (Smidtbleicher, D; 1992).

During the tenth FINA World Championship 94 players from eight various national teams were subdued to the test of maximal ball speed while shooting. It was confirmed that the average ball speed was 73 km/h (Darras, 1998). There were not statistically significant varieties among teams. It was also confirmed that waterpolo ball speed values were lower than in other sports such as baseball 108-135 km/h (Hakkinen, K. 1994) and handball 62-85km/h (Dintiman, G. 2001). There are certain varieties because waterpolo activity is performed in specific media – water – which significantly decreases ability of power generating while controlling the ball. Enoka, R. (1994) did analytic research of junior and senior players on the international level. He confirmed that better shooters had faster hip than shoulder rotation. At the same time weaker executors had an equal rotation. Faster hip rotations were also identified as essential for achieving maximum throwing speed at court sports such as baseball and javelin throw. Seagrave, L. (1996) points that, beside afore mentioned moves, vertical jump out of water is highly significant factor for achieving maximum throwing speed. The use of wrist as a part of kinetic chain is active while shooting the ball. Controlling the ball becomes obvious problem if the wrist does not function in the right way. Therefore, women, who naturally have extremities of smaller size find it more difficult to control the ball, because they do not have clearly defined wrist flexion.

METHOD

Examinee sample

Examinee sample consisted of 25 watrepolo players of various quality level in Banja Luka region in season 2010/11, when there was the estimation of: technique significance, “scissors” quality on the power of thowing the watrepolo ball in optimal conditions of actual muscle, as well as after local fatigue, *and the estimation of maximal examinee power during the shot simulaton by the application of classical dynamometry.* The examinee technique was estimated by the group of experts evaluating them 5 to 10. On the basis of those grades, the sample was divided into three quality groups: masters (4 examinees), average waterpolo players (16 examinees) and beginners (5 examinees).

Variable samples

Predictor variables

- *Waterpolo ball throwing technique*
- *Examinee endurance in the "scissors" position*
- *Maximum power estimation during waterpolo shot*

Criterial variables

- *Waletrpolo ball throwing duration*
- *Ball throwing in the conditions of locat fatigue*

Test description

"Scissors" quality was indirectly estimated by the time spent in the jump position. The throw power was evaluated by the reached duration while the maximal power was estimated by the electronic dynamometer during the shot simulation at real conditions i. e. in the pool. Local fatigue was a consequence of continuous shot simulations with the elastic band. Collected data were processed by the descriptive and comparative statistics, with the domination of non-parametric procedures, considering the small number of the examinees and asymmetric sample distribution.

RESULTS WITH THE DISCUSSION

Table 1.1-1 *Examinee distribution actualized according to the expert evaluation of waterpolo technique*

No.	Subsample	Absolute frequencies	Relative frequencies
1.	Masters	4	**16%**
2.	Average waterpolo players	16	**64%**
3.	Waterpolo beginners	5	**20%**
	∑	**25**	**100%**

Figure 1.1-1 Examinee distribution actualized according to the expert evaluation of waterpolo technique

According to six anticipated grades (5, 6, 7, 8, 9 and 10) examinees were classified into three evaluational categories (Table and Figure X.1-1). However, none of the examinees got 10, so only four of them who got nine were classified into the best group, marked as masters of waterpolo technique. Those who got 7 and 8 were marked as the examinees with the average technique level and the ones with grades 5 and 6 were marked as waterpolo beginners (Table and Figure X.1-2). Among 25 examinees majority was marked as average (16 examinees or 64%), and significantly less number with minimal and maximal evaluational continuum (16% masters and 20% beginners).

Table X.1-2 *Expert evaluation distribution for waterpolo techniques for 25 examinees*

Expert evaluation	Absolute frequencies	Relative frequencies
5	1	**4%**
6	4	**16%**
7	11	**44%**
8	5	**20%**

9	4	**16%**
10	**0**	**0**

Figure X.1-2 Expert evaluation distribution for waterpolo techniques for 25 examinees

Table X.1-3 *Descriptive statistic parameters gained on the basis of the waterpolo technique expert evaluation. The significance of subsamples varieties was testes by the Kruskal Wallis test.*

Subsample	Average (M)	Std. Er.	Std. Dev.	Min	Max
Masters	**9,00**	0,000	0,000	9	**9**
Average waterpolo players	**7,31**	0,479	0,120	7	**8**
Waterpolo beginners	**5,80**	0,447	0,200	5	**6**
Total sample	**7,28**	**1,061**	**0,212**	**5**	**9**

χ^2 = 19,385* *Sig.* =.000

Table 2.2-1 *Original data of measuring gained in the the best quality players' subsample*

Examinee	Max. Power (N)	Scissors (seconds)	Optimal kick out	Kick out during fatigue
1.	630,8	6,40	42	**34**
2.	475,3	5,00	31	**26**
3.	460,6	6,10	35	**28**
4.	**515,7**	**7,00**	**38**	**30**

Table 2. .2-2 *Original data of measuring gained in the the average quality players' subsample*

Examinee	Max. Power (N)	Scissors (seconds)	Optimal kick out	Kick out during fatigue
5.	412,0	6,00	34	**29**
6.	407,4	6,20	34	**33**
7.	401,5	5,35	38	**28**
8.	355,8	5,10	30	**27**
9.	350,7	4,10	28	**26**
10.	387,5	3,20	28	**25**
11.	383,9	4,20	25	**20**
12.	360,0	3,50	31	**25**
13.	348,5	4,10	32	**24**
14.	310,7	4,30	30	**24**
15.	310,4	3,15	25	**20**
16.	300,6	3,40	28	**22**
17.	300,5	3,00	22	**19**
18.	294,4	3,50	28	**26**
19.	254,4	2,20	23	**19**
20.	**230,4**	**2,55**	**25**	**20**

Table 2 .2-3 *Original data of measuring gained in the the beginner players' subsample*

Examinee	Max. Power (N)	Scissors (seconds)	Optimal kick out	Kick out during fatigue
21.	282,2	3,25	26	**20**
22.	280,3	2,20	24	**20**
23.	256,8	2,15	24	**18**
24.	249,9	3,00	22	**18**
25.	**208,4**	**3,10**	**22**	**20**

On the basis of the original measured results (Tables 2 .2-1, 2 .2-2 and 2 .2-3), for each sample separately, representative central and disperse statistic parameters were determined for four variables: two predictive "scissors" and two criterial variables (the kick out duration before and after fatigue).

Table 2 .2-4 *Descriptive statistic parametres determined for the best quality players' subsample*

Variable	Average (M)	Std. Er.	Std. Dev.	Min	Max
Maximal power (N)	**520,6**	77,072	38,536	460,6	**630,8**
Scissors (seconds)	**6,125**	0,838	0,419	5	**7**
Optimal kick out (m)	**36,5**	4,655	2,327	31	**42**
Kick out during fatigue (m)	**29,5**	**3,416**	**1,708**	**26**	**34**

Table 2.2-5 *Descriptive statistic parametres determined for the average quality players' subsample*

Variable	Average (M)	Std. Er.	Std. Dev.	Min	Max
Maximal power (N)	**338,044**	54,61	13,653	230,4	**412**
Scissors (seconds)	**3,99**	1,17	0,293	2,2	**6,2**
Optimal kick out (m)	**28,81**	4,339	1,085	22	**38**
Kick out during fatigue (m)	**24,19**	**4,02**	**1,005**	**19**	**33**

Table 2 .2-6 *Descriptive statistic parametres determined for the average quality players' subsample*

Variable	Average (M)	Std. Er.	Std. Dev.	Min	Max
Maximal power (N)	**255,52**	29,914	13,378	208,4	**282,2**
Scissors (seconds)	**2,74**	0,524	0,234	2,15	**3,25**
Optimal kick out (m)	**23,6**	1,673	0,748	22	**26**
Kick out during fatigue (m)	**19,2**	**1,095**	**0,49**	**18**	**20**

Results were presented into three tables (2 .2-4, 2 .2-5 and 2 .2-6). Absolute values of arithmetic means show the best results gained by the examinees from the best quality group (the examinees with the highest evaluations of throwing technique) and the lowest results gained by the examinees from the lowest quality group. Statistic significance total was later confirmed by the discriminative analysis (part X.3). Dispersive parametres' values pointed at high level of examinees' homogeneity within the specific samples.

On the basis of the original measured results (Tables 2 .2-1, 2 .2-2 and 2 .2-3), for each sample separately, representative central and disperse statistic parameters were determined for four variables: two predictive ”scissors” and two criterial variables (the kick out duration before and after fatigue).

Table 3 .3-1a *Absolute average values of three subsamples in various variables with the statistics of Kruskal Wallis test*

Variable	Masters	Average	Beginners	H	*Sig.*
Maximal power (N)	520,6	338,044	255,52	*14,970**	***,001***
Scissors (seconds)	6,125	3,99	2,74	*11,957**	***,003***
Optimal kick out (m)	36,5	28,81	23,6	*12,014**	***,002***
Kick out during fatigue (m)	**29,5**	**24,19**	**19,2**	***11,171****	***,004***

Table 3 .3-1b *Average ranges of subsamples with the statistics of Kruskal Wallis test*

Variable	Ranges Masters	Ranges Average	Ranges Beginners	H	*Sig.*
Maximal power	23,50	13,06	4,40	*14,970**	***,001***
Scissors	22,25	13,13	5,20	*11,957**	***,003***
Optimal kick out	22,00	13,25	5,00	*12,014**	***,002***
Kick out during fatigue	**21,38**	**13,38**	**5,10**	***11,171****	***,004***

An adequate non-parametric discriminative test for more separate samples, *Kruskal Wallis* test, was used for the purpose to test varieties between average values (arithmetic values) of three subsamples (three levels of waterpolo technique – masters, average and beginners). It was based on comparison of range values (Tables 3.3-1a and 3.3-1b and Figure 3.3-1). The other aspect of discrimination included comparison of complemetary crterial variables' average values which were observed in different circumstances of waterpolo ball throwing – before and after fatigue. Since the object of testing were the significance of varieties between two statistic series formed by testing the same group in two time references, *Wilcoxon* test was used as an adequate discriminative procedure for the dependable samples.

Kruskal Wallis test (Tables 3.3-1a and 3.3-1b) statistics confirmed that the varieties between average values of arithmenic means of three subsamples in six directly measured variables were statistically significant. In all variables statistically significant highest values were confirmed for the group of examinees with highest technique evaluation (masters), and lowest for the group of examinees whose ball throwing technique in the pool gained lowest grades (five and six). Even in five out of six comparisons, actualized level of significance were far below the theoretic limit (*Sig.*<,05), which was necessary to accept varieties as statistically significant.

Table X.3-1 *Spirman Rang-corelational analysis results implemented on predictor variables. Spirman coefficients' values are below, and realized significance levels above the diagonal.*

Variable	Technique evaluation	Maximal Power	Scissors
Technique evaluation	**1**	*,000*	*,000*
Maximal power	,867*	**1**	*,000*
Scissors	,836*	,883*	**1**

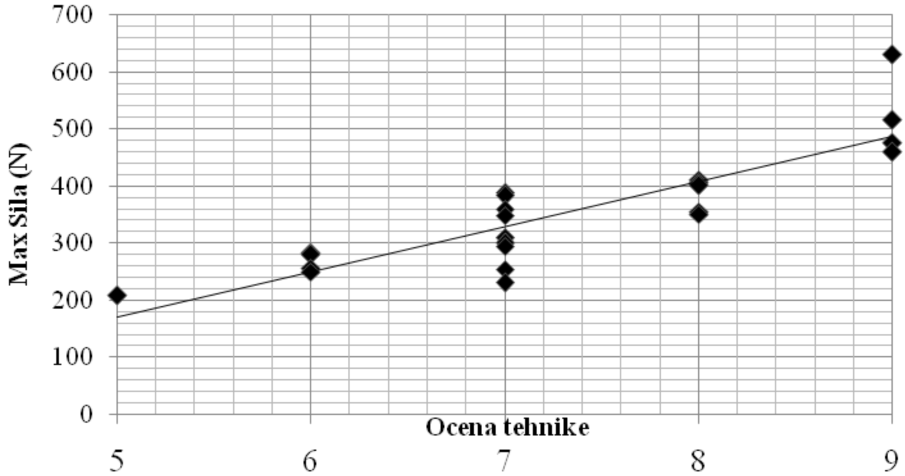

Figure X.3-1a *Scater diagram gained from Spirman Rang-corelation for variables Technique evaluation and Maximal power*

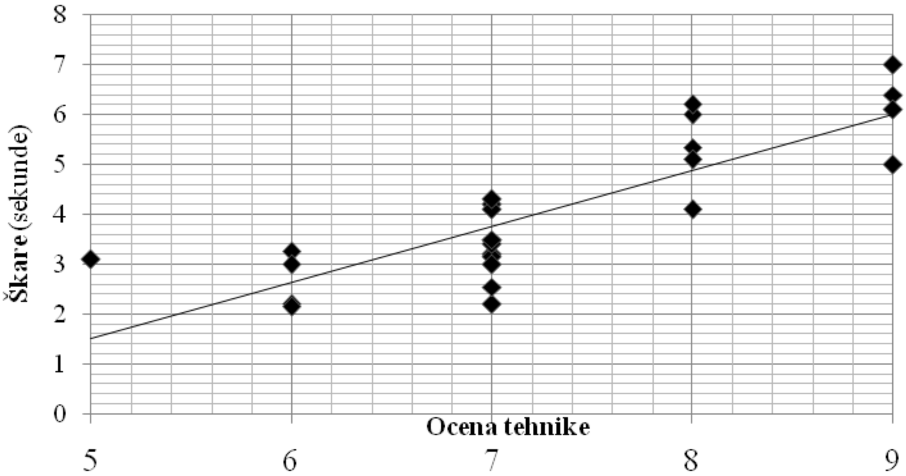

Figure X.3-1b *Scater diagram gained from Spirman Rang-corelation for variables Maximal power and "Scissors" quality*

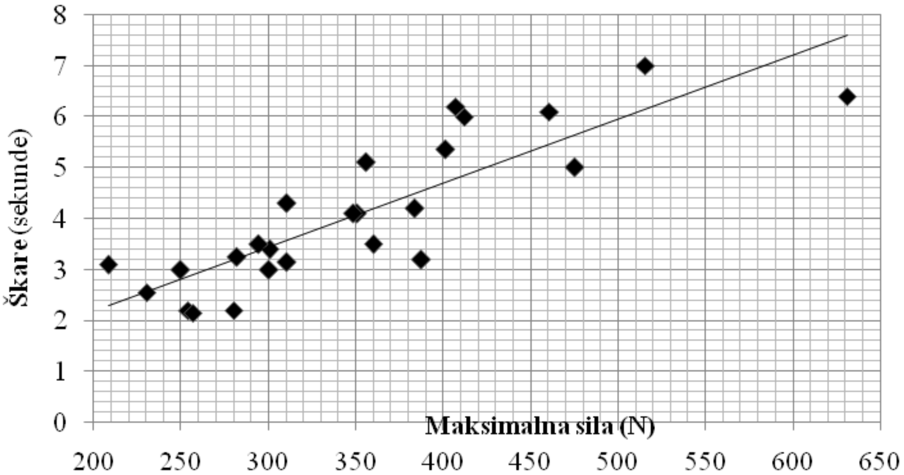

Figure X.3-1c *Scater diagram gained from Spirman Rang-corelation for variables Maximal power and "Scissors" quality*

All Spirman's corelational coefficients, calculated between predictor variables, were very high. Their statistic significance was confirmed by maximally low values of realizational significant level (Sig.<,01), which completely approached zero (Table X.3-1), in all three cases. Therefore, corelational points, showed in scater diagrams (Figures X.3-1a, X.3-1b and

X.3-1c in all three cases were very close and correctly categorized, so they undoubtedly pointed on positive (almost linear) deterministic relation between each of predictor variables.

CONCLUSION

The sample of 25 waterpolo players of different quality level was subdued to the following estimations: the importance of "scissors" quality on the intensity of ball kick out under the optimal actual muscle condition, as well as after local fatigue. Also the maximal power was estimated during the shot simulation. The examinee technique was estimated by the group of experts grading them 5 to 10. On the basis of those grades, the sample was divided into three quality groups: masters (4 examinees), average waterpolo players (16 examinees) and beginners (5 examinees). "Scissors" quality was indirectly estimated by the time spent in the jump position. The throw power was evaluated by the reached duration. Collected data were processed by the descriptive and comparative statistics, with the domination of non-parametric procedures, considering the small number of the examinees and asymmetric sample distribution. On the basis of the data, the conclusion is following:

All variables show statistically significant highest values confirmed for the group of examinees with highest technique grades (masters), and lowest for the group of examinees whose ball throwing technique in the pool gained lowest grades (five and six). Even in five out of six comparisons, actualized level of significance were far below the theoretic limit (*Sig.*<,05), which was necessary to accept varieties as statistically significant. Post-Hoc analysis application confirmed that there were statistical varieties within that variable. Results of best quality waterpolo player group were statistically singnificanty better than results of the rest two subsamples, while there were no differences between middle and the lowest quality group. It seems that waterpolo players with lower technique level have greater consequences caused by the local fatigue.

Gained corelations clearly showed that there was a significant positive relation between predictor variables, so it could be expected that everything would affect dependable variables in the similar way. Moreover, technically more quality players have the ability of creating the stronger power in the pool, as well as the ability to hold "scissors" position longer (the higher the technique evaluation was, the higher was the intensity of examinee maximal power, as well as performing "scissors" position). Agnized statistical law is congruent with actual waterpolo coaches' attitude (and explains it, too) that the ability of powerful and precise ball throw (throwing or shooting) depends of quality "scissors" position performance, so modern methodology that studies waterpolo techniques pays the greatest attention to this element. Tight numerical relation between the time spent in "scissors" position and measured maximal power during shoot simulation show that the effect of good "scissors" technique projects on total technical success by taking as much quality and, biomechanically observing, as much rational position for completing greater power and strength. Breaking out of water, waterpolo players create conditions for completing far stronger torque in clamps of shoulder belt and spinal column, and at the same time, they eliminate negative impact of water to the loose extremity.

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