

**ARE DISCIPLINES IN ALL AROUND MEN'S ARTISTIC GYMNASTICS EQUAL?****Ivan Čuk<sup>1</sup>, Almir Atiković<sup>2</sup>**<sup>1</sup>*Faculty of Sport, University of Ljubljana, Slovenia*<sup>2</sup>*Faculty of Physical Education and Sport, University of Tuzla, Bosnia and Herzegovina**Original scientific article***Abstract**

*On the sample of the 44 gymnasts who competed at the OG 2008 in Beijing in all around, the equality between disciplines was tested. Equality was tested for the achieved A scores on the disciplines of floor exercise, pommel horse, rings, vault, parallel bars and horizontal bar. Vault has the highest A scores, while pommel horse the lowest A scores. T-tests showed that those two disciplines significantly differ from other disciplines in average for 0,4 points. Factor analysis extracted 3 factors, with 67% of explained variance. On the 3<sup>rd</sup> factor vault on positive side and pommel horse on the negative side were loaded. According to the 2006 Code of points and gymnastics training theory, both have to be revised.*

**Key words:** *male artistic gymnastics, Code of Points, Olympic Games, judging*

**INTRODUCTION**

After a huge affair at the OG 2004 where in all around USA gymnast won in front of Korean gymnast, many consequences made by FIG were done. One of it was also implementation of the new philosophy of open scoring system (Čuk, Forbes, 2006). Before 2006 all the disciplines were limited by maximum final score. During the past different maximum scores were allowed. Before the WWII maximum score was sometimes between 11 and 16 points; after the WWII maximum score was limited to 10 points (Čuk, 1998). As the development of the Code progressed it came to the point of no return. Despite many changes what 10 points means, in general 10 score is the mark of exercise content and exercise presentation. Proportion between those two factors was also changing; at the end it became equal to 50:50 percent. Exercise content was mostly characterized by difficulty (which was sometimes designed, later, and slightly open for bonus points for extreme difficulty elements or their combination) and special requirements (requirement for special group of elements, which emphasis character of apparatus). In the Code 2006 (FIG, 2006) the whole philosophy of evaluating gymnastics exercises changed. No more one maximum score was used for evaluating exercises. New rules defined A and B score, where A score means exercise content (difficulty, special requirement and bonus points) and B score means exercise presentation. A score goes from zero points upward according to what difficulty gymnast shows (calculating 10 most difficult elements), how exercise is constructed (exercise must include elements from all five

element groups, not more than 4 from one group) and how difficult elements are connected (bonus) points. System for discipline specialist works excellent, more you show greater scores. However in all around the problem can exist. Problem is within equality between disciplines as vault has special rules, comparing to floor exercise, pommel horse, rings, parallel bars and horizontal bar. Gymnast on vault shows in all around one vault. Comparing to other disciplines vault is similar to one element from the exercise. Therefore on the vault for each vault the A score is known in advance (Čuk at all, 2007). As some disciplines (pommel horse, parallel bars) have no bonus points it is worth to consider how in practice are all disciplines for all around gymnasts equal.

In other Olympic sports e.g. decathlon or similar they use special tables to give for each result adequate points. The highest number of points is related to the best world results. However, the best decathlon athletes can not compete with best athletes in specific disciplines. Same we can say according to the results of World Championship 2007 (FIG, 2007), where best all around gymnasts did not have any huge impact on medals on apparatus finals.

At OG 2008 (FIG, 2008) competed the best all around gymnasts from the whole world, with time span of 2 years preparing for the best results in all around. In general at the OG the highest scores in Olympic cycles are always

achieved (Novak, Čuk, 1985). With inspection into the equality of disciplines we can also receive trends of modern all around gymnasts. For above reasons it is worth to test how all around gymnasts solved problem of equality of disciplines.

**METHODS**

Our sample was composed of 44 all around gymnasts who competed at the OG in Beijing

2008 in qualification event. From official results we made 6 variables of A scores: FX

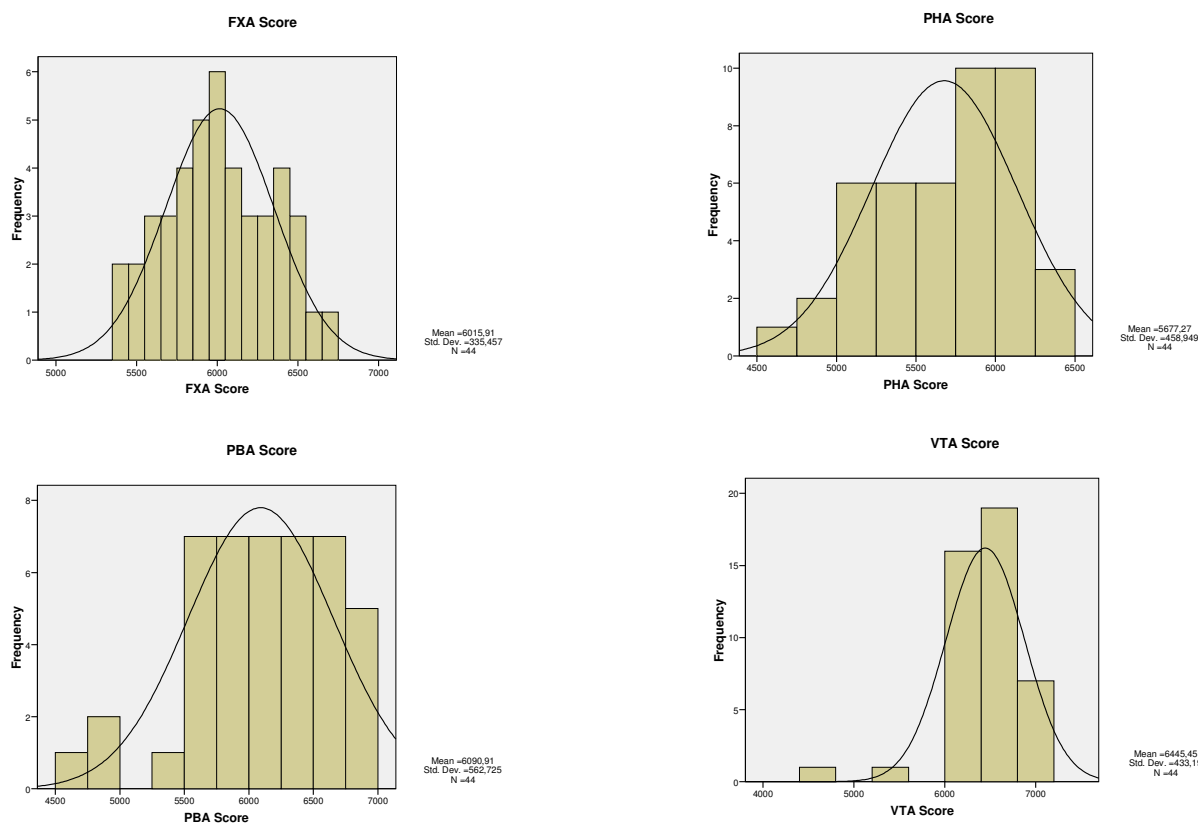
(floor exercise), PH (pommel horse), RI (rings), VT (vault), PB (parallel bars) and HB (horizontal bar). For easier statistics presentation A score is multiplied by 1000; so A score of 6 points has value of 6000 in statistic tables. With SPSS 15.0 we calculated descriptive, Kolmogorov-Smirnov test, Pearson correlations, and pair wise t-test between A scores of all disciplines. At the end we did also factor analysis, with scree test we defined 3 important factors, and solution was rotated with Varimax method. For significance 5 percent level was considered for all statistic parameters.

**RESULTS**

Table 1. Descriptive statistic

	N	Mean		Std. Dev	Skewness		Kurtosis	
		Stat.	Std. Er.		Stat.	Std. Er	Stat.	Std. E
FXA Score	44	6015,91	50,572	335,457	,049	,357	-,753	,702
PHA Score	44	5677,27	69,189	458,949	-,226	,357	-,693	,702
RIA Score	44	5943,18	95,257	631,866	,123	,357	-,189	,702
VTA Score	44	6445,45	65,306	433,190	-1,918	,357	7,049	,702
PBA Score	44	6090,91	84,834	562,725	-,585	,357	,141	,702
HBA Score	44	5897,73	80,530	534,176	-,109	,357	-,328	,702

Graph 1. Histograms of all variables



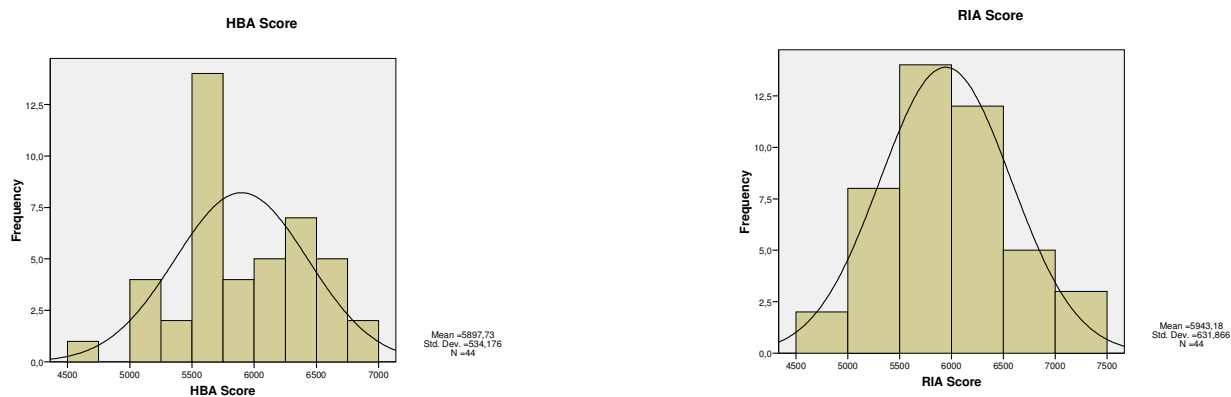


Table 2. Kolmogorov Smirnov test

		FXA Score	PHA Score	RIA Score	VTA Score	PBA Score	HBA Score
N		44	44	44	44	44	44
Normal Parameters a,b	Mean	6015,91	5677,27	5943,18	6445,45	6090,91	5897,73
	Std. D.	335,457	458,949	631,866	433,190	562,725	534,176
Most Extreme Differences	Absolute	,087	,133	,100	,240	,118	,122
	Positive	,087	,090	,093	,202	,061	,122
	Negative	-,078	-,133	-,100	-,240	-,118	-,099
Kolmogorov-Smirnov Z		,578	,885	,665	1,592	,781	,807
Asymp. Sig. (2-tailed)		,892	,414	,769	,013	,576	,533

a Test distribution is Normal.

b Calculated from data.

Table 3. T-test between all disciplines

		Paired Differences							
		Mean	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Upper	Lower			
Pair 1	FXA Score - PHA Score	338,636	607,019	91,512	154,086	523,187	3,700	43	,001
Pair 2	FXA Score - RIA Score	72,727	750,926	113,206	-155,575	301,030	,642	43	,524
Pair 3	FXA Score - VTA Score	-429,545	511,532	77,116	-585,065	-274,026	-5,570	43	,000
Pair 4	FXA Score - PBA Score	-75,000	583,942	88,033	-252,535	102,535	-,852	43	,399
Pair 5	FXA Score - HBA Score	118,182	528,391	79,658	-42,464	278,827	1,484	43	,145
Pair 6	PHA Score - RIA Score	-265,909	749,866	113,047	-493,889	-37,929	-2,352	43	,023
Pair 7	PHA Score - VTA Score	-768,182	655,486	98,818	-967,468	-568,896	-7,774	43	,000
Pair 8	PHA Score - PBA Score	-413,636	647,927	97,679	-610,624	-216,648	-4,235	43	,000
Pair 9	PHA Score - HBA Score	-220,455	709,923	107,025	-436,291	-4,618	-2,060	43	,045
Pair 10	RIA Score - VTA Score	-502,273	743,495	112,086	-728,316	-276,229	-4,481	43	,000
Pair 11	RIA Score - PBA Score	-147,727	701,987	105,828	-361,151	65,696	-1,396	43	,170
Pair 12	RIA Score - HBA Score	45,455	822,490	123,995	-204,605	295,514	,367	43	,716
Pair 13	VTA Score - PBA Score	354,545	680,101	102,529	147,776	561,315	3,458	43	,001
Pair 14	VTA Score - HBA Score	547,727	666,294	100,448	345,155	750,299	5,453	43	,000
Pair 15	PBA Score - HBA Score	193,182	618,474	93,239	5,148	381,215	2,072	43	,044

Table 4. Pearson's Corellations

		N	Correlation	Sig.
Pair 1	FXA Score & PHA Score	44	-,147	,341
Pair 2	FXA Score & RIA Score	44	-,123	,427
Pair 3	FXA Score & VTA Score	44	,133	,391
Pair 4	FXA Score & PBA Score	44	,234	,127
Pair 5	FXA Score & HBA Score	44	,331	,028
Pair 6	PHA Score & RIA Score	44	,082	,596
Pair 7	PHA Score & VTA Score	44	-,079	,611
Pair 8	PHA Score & PBA Score	44	,208	,175
Pair 9	PHA Score & HBA Score	44	-,016	,916
Pair 10	RIA Score & VTA Score	44	,062	,688
Pair 11	RIA Score & PBA Score	44	,314	,038
Pair 12	RIA Score & HBA Score	44	,012	,938
Pair 13	VTA Score & PBA Score	44	,086	,580
Pair 14	VTA Score & HBA Score	44	,063	,686
Pair 15	PBA Score & HBA Score	44	,365	,015

Table 5. Factor analysis – explained variance – principal component analysis

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,693	28,212	28,212	1,575	26,242	26,242
2	1,340	22,338	50,551	1,360	22,664	48,906
3	1,025	17,079	67,630	1,123	18,724	67,630

Table 6. Factor analysis – rotated component matrix – Varimax

	Component		
	1	2	3
FXA Score	,759	-,194	,242
PHA Score	-,021	,384	-,664
RIA Score	-,114	,830	,073
VTA Score	,073	,317	,770
PBA Score	,584	,617	-,155
HBA Score	,799	,074	-,044

**DISCUSSION AND CONCLUSIONS**

Descriptive statistics and Kolmogorov Smirnov test show all variables except vault A score are normal. Higher values kurtosis and skewnes are by vault A score what causes this variable hasn't normal distribution. Average A score values are on the vault the highest, while standard error is the second smallest. Series of t-tests shows the A scores on vault are significantly higher than on all other apparatus. Out of 15 t-tests only 5 are not significant. All pairs and differences between vault and other disciplines are significant; same is valid for pommel horse. While A scores for vault are the highest, the pommel horse A scores are the lowest, the difference between vault and

pommel horse A score is 0,76818 points. If we translate it into the difficulty (each element in the Code of Points has designed value, value of 0,1 is designed for the easiest element (also named A element); with increments of 0,1 point for next higher difficulty (named B, C, D, E, F, G) vault is in average better rewarded for one C and one D element. Only 3 significant positive correlations were calculated; high bar A score is in a low correlation with floor exercise A score and parallel bars A score; parallel bars A score was also in low correlation with rings A score.

Factor analysis extracted 3 significant factors (by Kaiser Gutman criteria and scree test); orthogonal rotated factors have quite similar

explained variance (26% the first factor, 22% the second factor and 19% the third factor). The first factor was loaded with floor exercise A score, parallel bars A score and horizontal bar A score. The second factor was loaded with rings A score and parallel bars A score. The third factor was loaded with vault A score on the positive side and pommel horse A score on the negative side. As a conclusion we can say disciplines are not equal. Gymnasts have the highest A score values on vault. According to simplicity of the vault (comparing to other disciplines, not stating vault is easy!) those who vault good have possibility of higher final

score of all around. Vault is according to the analysis of the training loads also discipline with the lowest amount of time spent (Čuk, Karacsony, 2004). On the other side the lowest A scores were on pommel horse; pommel horse is a discipline which requires the highest amount of time spent in training session. Interesting both disciplines formed joint factor, which shows, that in order to maximize all around scores it is better to work less on pommel horse and more on vault. While other disciplines are quite equal in sense of A scores and time spent during training session. At least what can be done in the next Code of Points is to lower A scores on vault for 0,4 points and to raise possibility to get similar A score on other apparatus.

## LITERATURE

- Čuk, I. (1998). Razvoj tekmovanj v športni gimnastiki od prvega mednarodnega nastopa Leona Štuklja leta 1924 do 1998. *Šport (Ljublj.)*, 1998, let. 46, št. 3, str. VI-VII.
- Čuk, I., Bricelj, A., Bučar Pajek, M., Turšič, B., Atiković, A. (2007). Relationship between start value of vault and runway velocity in top level male artistic gymnastics. V: SMAJLOVIČ, Nusret (ur.). *Zbornik naučnih i stručnih radova-dodatak*. Sarajevo: Univerzitet, Fakultet sporta i tjelesnog odgoja, 2007, str. 64-67, ilustr., tabele.
- Čuk, I., Forbes, W. (2006). Kam greš, sojenje?. V: KOLAR, Edvard (ur.), PILETIČ, Sebastijan (ur.). *Gimnastika za trenerje in pedagoge 2*. Ljubljana: Gimnastična zveza Slovenije, 2006, str. 76-86, ilustr.
- Čuk, I., Karacsony, I. (2004). *Vault : methods, ideas, curiosities, history*. Ljubljana: ŠTD Sangvinčki, 2004. 151 str., ilustr., graf. prikazi. ISBN 961-238-393-6.
- FIG (2000). Code of Points MAG.
- FIG (2006). Code of Points MAG.
- FIG (2007). Results of World Championship in Stuttgart.
- FIG (2008). Results of OG 2008 in Beijing.
- Novak, D., Čuk, I. (1985). *Razvoj tekmovalnega rezultata v športni gimnastiki*, (Razvoj tekmovalnega rezultata v športni gimnastiki), (Proučevanje vpliva različnih kinezioloških operatorjev na psihosomatične razsežnosti učencev, športnikov in odraslih oseb). Ljubljana: Fakulteta za telesno kulturo, Inštitut za kineziologijo, 1985. 126 f., graf. prikazi.

### DA LI SU DISCIPLINE U MUŠKOM GIMNASTIČKOM VIŠEBOJU RAVNOPRAVNE?

*Originalni naučni rad*

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#### **Sažetak**

*Na uzorku od 44 gimnastičara, koji su se takmičili u Olimpijskim igrama 2008 u Pekingu u višeboju, testirana je ravnopravnost između disciplina. Jednakost je testirana za postignute rezultate dodjeljene od A sudijske komisije, za parter, konja sa hvataljkama, krugove, preskok, razboj i vratilo. Ocjena na preskoku A sudijske komisije ima najvišu vrijednost, dok je ocjena na konju sa hvataljkama najmanja. T-testovi su pokazali da se ove dvije discipline bitno se razlikuju od drugih disciplina u prosjeku za 0,4 poena. Faktorska analiza izolovana 3 faktora, objašnjava 67% varijance. Na 3 faktorom svodu na pozitivnoj strani je preskok a konj sa hvataljkama na negativnoj strani bio učitani. Prema Pravilniku za ocjenjivanje iz 2006 godine i gimnastika teoriji treninga, moraju se revidirati.*

**Ključne riječi:** *gimnastičari, olimpijske igre, suđenje*

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