ELITE FEMALE VAULT FINALS FROM 2008 – 2016

Sunčica Delaš Kalinski¹, Goran Jelaska² and Almir Atiković³

¹University of Split, Faculty of Kinesiology, Split, Croatia ²Virovitica General Hospital, Virovitica, Croatia ³University of Tuzla, Faculty of Physical Education and Sport, Tuzla, Bosnia and Herzegovina

Abstract

After Vault Qualifications (in C-I competition), the top eight scores, maximum two gymnasts from one national team, qualify for Vault Finals. During the Vault Finals, these top female vaulters need to perform two different vaults. The aim of this study was to determine: 1) trends of the Difficulty Scores (DS), Execution Scores (ES) and Total Scores (TS) of the first vault and the second vault; 2) differences between differently ranked gymnasts (Medal Winners vs Non-Medal Winners) on all major competitions held from 2008 to 2016. An increase in results of all scores, from initial competition (OG2008) to final competition (OG2016), confirms the progress in quality and complexity of the female vaults. Numerically higher values of all scores have been demonstrated for Medal Winners compared to Non-Medal Winners, but only some of them have been determined to be significant. The ES has been determined as the score that makes the difference among differently ranked gymnasts.

Key words: women's artistic gymnastics, gymnasts rank, 2×11 ANOVA.

Introduction

Vault is one of four apparatuses in Women's Artistic Gymnastics (WAG). Until 2001, the vault was along cylindrical structures similar to the pommel horse. Then it was changed to the current table. This change was made to provide safer vault preformances after several gymnasts "rammed into the horse" or misplaced their hands during the 2000 Sydney Olympics. As movements, vaults are very complex motor skills that need to be performed in a very short time (most vaults, on average, don't last more than seven seconds) and differ in terms of the time structure of one or more of seven vault phases: approach, flight to springboard, springboard actions, the first flight phase, the second flight phase and landing (Čuk & Karácsony, 2004). Taking this into account, the Women's Artistic Gymnastics Code of Points (WAG CoP) has classified all vaults into five groups. According to the CoP, the Difficulty Value (DV) of each vault is pre-determined based on the number of rotations (along the transversal and longitudinal axis in the first and second flight phase) and the intended body position—tucked, piked or stretched (Atiković & Smajlović, 2011). Each vault in the Table of Vaults (WAG CoP 2009, 2013) is presented with its own number and predefined DV. One of the WAG CoP rules states that, if they want to qualify for the Vault Finals (C-III), during the Vault Qualification (C-I) gymnasts need to perform two vaults that show different repulsion phase (WAG CoP, 2009), that is, two vaults from different groups with different second flight phases (WAG CoP, 2013). Further, in the Vault Finals gymnasts also need to perform two different vaults. Competitors can perform any vault, usually the most difficult vault that they can perform successfully. The Total Scores (TS) of those two vaults are parts of the equation that creates the Final Score (FS):

\[ FS = \frac{DVTS1 + DVTS2}{2} \] (each vault Total Scores added together and then averaged). In C-I, the value of the FS determines who qualifies for the Vault Finals (top eight scores; maximum two gymnasts from one national team); in C-III the value of the FS determines the rank of the gymnasts. The complexity of the vault can also been seen through the results of Delaš Kalinski et al. (2016). The authors determined that during the period from 2008 to 2015, at all major competitions which were not Team Finals competitions (C-IV), the percentage of Vault Qualifiers was from 81.03% (WC2009) to 90.90% (WC2013), while on the other analyzed competitions, only one-fifth of competitors were Vault Qualifiers (22.38% at the OG2008, 23.48% at the WC2010, 16.56% at the WC2011, 14.66% at the QOG2012, 36.00% at the OG2012, 15.13% at the WC2014 and 14.36% at the WC2015). At the QOG2016 the percentage of Vault Qualifiers was 11.11% and at the OG2016 23.18%. Some previous studies of vault also analyzed: a) the quality of judging on the vault (Atiković & Čuk, 2009; Leskošek, Čuk, Karácsony, Pajek, & Bučar, 2010; Bučar Pajek, Forbes, Pajek, Leskošek, Čuk, 2011; Bučar, Čuk, Pajek, Karácsony, & Leskošek, 2012; Leskošek, Čuk, Pajek, Forbes, & Bučar Pajek, 2012; Atiković, Delaš Kalinski, Bijelić, & Avdibašić Vukadinović, 2012). They determined that in the Men's Artistic Gymnastics (MAG), the vault is the most valuable apparatus for All-Around gymnasts and an apparatus on which it is easiest to obtain a high DS and the highest ES; b) differences between female junior and senior competitors in vault performances. They determined that the increased anthropometric characteristics of senior gymnasts compared to junior gymnasts probably contribute...
to better vault performances (Erceg, Delaš Kalinski, & Milić, 2014; Delaš Kalinski, 2015). Based on the assumption that among the best female vaulters there also exists a significant difference, the authors posed the problem of this paper. Accordingly, the main aim of this study was to analyse the differences between the values of the DS, ES and TS of the first and the second vaults of differently ranked female gymnasts in the Vault Finals of all major competitions held from 2008 to 2016. The second objective of this study was to identify the impact of Competitor Type (Medal Winners or Non-Medal Winners), Competition and their interaction on DS, ES and TS at all major competitions from 2008 to 2016.

Methods


The sample has been divided into two groups, depending on their rank (ranked 1-3 and ranked 4-8). The variables sample is represented by a set of Difficulty Scores (DS), Execution Scores (ES) and Total Scores (TS) obtained for a performance of the first and the second vaults in Vault Finals (C-III) competition.

The values of the mentioned scores have been taken from the Internet (www.gymnasticsresults.com, accessed 18th October 2016; http://www.longinestiming.com/, accessed 28th April 2015). Previous studies presented detailed descriptive parameters of analyzed variables from the same competitions (Massida & Calo, 2012; Leskošek, Čuk, & Bučar, 2013; Erceg, Delaš Kalinski, & Milić, 2014), as well as generally satisfactory metric characteristics of those scores (Bučar, Čuk, Pajek, Karácsony, & Leskošek, 2012; Bučar Pajek, Čuk, Pajek, Kovač, & Leskošek, 2013). Data analysis included calculations of Mean±Standard deviations. Data has been checked for univariate and multivariate outliers. None was found (p>.05). Due to identification of influence of factors Competition (2008-2016) and Competitor Type (Medal Winners vs Non-Medal Winners) and their interaction on DS, ES and TS, 2×11 factorial analysis of variance (ANOVA) was applied together with post-hoc Fisher’s least-squares difference (LSD) test when needed.

(Partial) $\eta^2$ was used for effect size assessment. Data were considered significant if p.<.05. All calculations were performed using software package Statistica 12.0. (StatSoft, Tulsa, Oklahoma, USA).

Results


Figures 1-6. Mean Values ± Standard Deviations for the variables DS, ES and TS of the first and the second vaults performed by differently ranked vault finalists

[Figures 1-6]

[Figure 1. Difficulty scores of the first vault of differently ranked vault finalists

[Figure 2. Difficulty scores of the second vault of differently ranked vault finalists]

from the scores determined at WC2011, a - significant difference from the scores determined at QOG2012, i - significant difference from the scores determined at OG2012, z - significant difference from the scores determined at WC2013, $ - significant difference from the scores determined at WC2014, B - significant difference from the scores determined at WC2015, c - significant difference from the scores determined at QOG2016, d - significant difference from the scores determined at OG2016; * - significant differences between differently ranked gymnasts at single competition.

Figure 3. Execution scores of the first vault of differently ranked vault finalists

Figure 4. Execution scores of the second vault of differently ranked vault finalists

Figure 5. Total scores of the second vault of differently ranked vault finalists

Figure 6. Total scores of the second vault of differently ranked vault finalists

Regarding to different rank of Vault Finalists, the main effect of Competition was found to be significant for the DS of the first vault \((F_{10,65}=2.509; p=0.013; \eta^2=0.087)\), ESoF the first vault \((F_{10,65}=2.809; p=0.006; \eta^2=0.302)\) and for the TS of the first vault \((F_{10,65}=7.132; p<0.001; \eta^2=0.523)\). The main effect of the Competition was also found to be significant for the DS of the second vault \((F_{10,62}=4.241; p<0.001; \eta^2=0.406)\) and TS of the second vault \((F_{10,62}=5.183; p<0.001; \eta^2=0.455)\), while was not found to be significant for the ESoS of the second vault \((F_{10,62}=1.136; p=0.351; \eta^2=0.155)\).

Regarding different ranks of Vault Finalists, the main effect of Rank was found to be significant for all variables of the first and the second vault: VT1DS \((F_{1,65}=6.158; p=0.016; \eta^2=0.087)\), VT1ES \((F_{1,65}=2.293; p<0.001; \eta^2=0.280)\), VT1TS \((F_{1,65}=51.402; p<0.001; \eta^2=0.442)\), VT2DS \((F_{1,62}=7.370; p=0.009; \eta^2=0.106)\), VT2ES \((F_{1,62}=21.437; p<0.001; \eta^2=0.257)\) and VT2TS \((F_{1,62}=42.695; p<0.001; \eta^2=0.408)\). Interaction Competition*Competitor Type appeared not to be significant for any analyzed variable: VT1DS \((F_{10,65}=1.142; p=0.170; \eta^2=0.018)\), VT1ES \((F_{10,65}=1.504; p=0.158; \eta^2=0.018)\), VT1TS \((F_{10,65}=1.077; p=0.392; \eta^2=0.014)\), VT2DS \((F_{10,62}=0.553; p=0.845; \eta^2=0.082)\), VT2ES \((F_{10,62}=1.495; p=0.163; \eta^2=0.019)\), VT2TS \((F_{10,62}=1.294; p=0.254; \eta^2=0.173)\).

Discussion and conclusion

At almost all analyzed competitions, Medal Winners had higher numerical values of DS compared to Non-Medal Winners. As expected, because only the best female vaulters qualify for Vault Finals, significant differences between differently ranked finalists have not been determined in the average values of VT1DS and VT2DS (excluding QOG2016). QOG2016 was primarily an All-Around competition, the last chance for All-Around competitors to qualify for OG2016, and the apparatus finals were organized as a 'test' for OG2016 (medals were not awarded). In the Vault Qualifications only 10 (primarily All-Around) gymnasts competed—
gymnasts who generally jump only one height DV vault. Accordingly, determined results are logical. Unlike VT1DS and VT2DS, during some of the analyzed competitions, significant differences have been found among differently ranked Vault Finalists in average values of the ES between VT1ESat QOG2012, OG2012, WC2013, and WC2014; further between VT2ESat WC2009, WC2013 and WC2015. Since the ES is formed by summing the deductions for errors in the vault execution, the conclusion is that differently ranked Vault Finalists differ in the quality of their vault performance. Explanation for those results can also be seen through the format of competitions on which significant differences between differently ranked gymnasts have been determined (they were mostly Individual All-Around Finals and Individual Event Finals). During these competitions, gymnasts exclusively compete for their own results (Delaš Kalinski, Atiković, Jelaska, & Milić, 2016), and thus likely chose to perform second vaults that have not yet been developed to the same level of quality as their first vault.

By performing them, they test their chances for the upcoming Olympic cycle. The importance of the quality of the performance (as opposed to DS of the jump) is further enhanced by the identification of significant differences in the TS, between differently ranked finalists, at the same competitions as in the ES. The exception is a significant difference in the TS at QOG2016; presumably the result of the significant differences in the values of DS of differently ranked Vault Finalists. Through analysis of the value of the percentage of DS and ES in the TS it was determined that DS, on average, makes up about 40% of the TS while the ES, on average, makes up approximately 60% of the TS. This doesn’t confirm results from previous studies and the conclusion that the DS is the score that generally determines the TS (Čuk & Atiković, 2009; Ćuk & Forbes, 2010; Bučar Pajek, Forbes, Pajek, & Leskošek, 2011; Bučar, Ćuk, Pajek, Karacsony, & Leskošek, 2012; Bučar Pajek, Ćuk, Pajek, Kovač, & Leskošek, 2013; Massida & Calo, 2012). Generally, it can be concluded that quality of performance is the most important determinant for winning a medal in the female Vault Finals. That might not be completely so, as results from OG2016 confirm. In fact, at this competition two competitors (Dipa Karmakar from India and Oksana Chusovitina from Uzbekistan) performed the Produnova vault, also called ‘vault of death’. It is the most difficult (and dangerous) vault, which generally demands considerable upper body strength in order to gain the needed height to rotate the body forward two times before hitting the mat (in approximately 2 seconds). Landing the Produnova is also difficult, and that is why it is said that this vault demands more power than skill. However, thanks to its difficulty, jumping the Produnova vault, even with a failure in execution, can lead to higher scores than do many other vaults from the world’s top gymnasts. Whether this type of competitive manoeuvre will be devalued in vault scoring by FIG, to prevent those who cannot complete it from performing it to take advantage of scoring advantages related to its difficulty remains to be seen. During the Vault Finals higher numerical values for DS, ES and TS have been determined for Medal Winners. Some of these differences have been determined as significant. Additionally, the increase of numerical values of DS of the first and the second vault, from the beginning to the end of the analyzed period, indicates that the vault is an apparatus that constantly develops in the direction of more and more difficult vaults. However, due to the influence and the percentage of ES in the TS, it is possible to conclude that the ES determines the final ranking in the Vault Finals for female gymnasts. Given that at least one demonstrated exception (the Produnova vault) exists, this conclusion should be accepted with caution.

References


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**FINALA PRESKOKA U VRHUNSKOJ ŽENSKOJ SPORTSKOJ GIMNASTICI OD 2008. DO 2016. GODINE**

**Sažetak**


**Ključne riječi:** ženska umjetička gimnastika, gimnastičko rangiranje, 2x11 ANOVA.

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Correspondence to:  
Assoc. Prof. Sunčica Delaš Kalinski, PhD  
University of Split  
Faculty of Kinesiology  
Teslina 6, 21000 Split, Croatia  
Tel: 00385 (099) 1 502 97 51  
E-mail: suncica@kifst.hr