Baltic Journal of Health and Physical Activity 2017;9(4):55-65
Journal of Gdansk University of Physical Education and Sport in Gdansk
e-ISSN 2080-9999

ORIGINAL

doi: 10.29359/BJHPA.09.4.05

Challenges of female vault finals for the 2008–2016 period

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Sunčica Delaš Kalinski[1 ABDEF], Almir Atiković[2 ADEF], Igor Jelaska[1 CDEG]

[1] Faculty of Kinesiology, University of Split, Croatia
[2] University of Tuzla, Faculty of Physical Education and Sport, Bosnia and Herzegovina

abstract

Background Women's Artistic Gymnastics (WAG) competitions are determined by the rules of the Code of Points (CoP) which experience changes in each new Olympic Games (OG). One of the WAG CoP rules states that in the Vault Finals, gymnasts need to perform two different vaults.

Material/Methods The aim of this study was to determine the quality of the vault performances and the differences between them during Vault Finals at all major competitions held from 2008 to 2016. Numerically higher values of Difficulty Scores, Execution Scores and Final Scores of the first vault compared to the scores of the second vault have been determined at all the analysed competitions.

Results The differences between the scores during different competitions have been determined as significant, but they have not been determined as significant between the scores achieved at the OG held in 2008, 2012 and 2016. Significant differences between the Difficulty Scores of the first and the second vaults have been determined at the World Championships (WC) 2010 and OG2012; and within Final Scores of the first and the second vaults at WC2009, WC2010, OG2012 and WC2015.

Conclusions It was concluded that female Vault Finalists performed two structurally different vaults of similar Difficulty Value equally well.

Key words women's artistic gymnastics, difficulty score, execution score, final score

article details

Article statistics **Word count:** 2,855; **Tables:** 0; **Figures:** 5; **References:** 21
Received: February 2017; **Accepted:** October 2017; **Published:** December 2017
Full-text PDF: http://www.balticsportscience.com

Indexation: Celdes, Clarivate Analytics Emerging Sources Citation Index (ESCI), CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
Conflict of interest: Authors have declared that no competing interest exists.
Corresponding author: Assist. Prof. Sunčica Delaš Kalinski, Ph.D.; Faculty of Kinesiology, University of Split; Teslina 6, 21000 Split, Croatia; mobile: +385915029751; e-mail: suncica@kifst.hr

INTRODUCTION

The vault is one of the four disciplines performed by gymnasts in Women's Artistic Gymnastics (WAG). Motor skills (vaults) performed on this apparatus, by their structure, are very complex. They are performed in a very short time and differ in time structure from one to seven vault phases: approach, flight to springboard, springboard actions, the first flight phase, support, the second flight phase and landing [1]. Taking this into account, the Women's Technical Committee (WTC) of the International Gymnastics Federation (FIG) has classified all the vaults into five structural groups. Within the same framework, every vault is assigned with a specific number and Difficulty Value (DV). Gymnasts arbitrarily choose the vaults they intend to perform for competition, and they are required to nominate the number of vaults before they perform. In this way, the judges are informed about the vault DV before the vault performance. After the vault performance, judges are required to: 1) assess whether the announced vault was performed; 2) assess whether the DV of the announced vault equalled the DV of the performed vault; 3) determine the Execution Score (ES is calculated as the average score of four judges; ES of each judge consists of the sum of the deductions for errors in execution deducted from 10.00 points).

In order to qualify for the Vault Finals (C-III), gymnasts must perform two vaults during the Vault Qualification (C-I) that exhibit different repulsion phases [2], which means they must perform two vaults from different groups and with different second-flight phases [3]. This simple equation is used to calculate the Final Score (FS) in Vault Qualifications and in Vault Finals: FS = FSVT1 + FSVT2 / 2. In C-I, the FS determines who qualifies for the Vault Finals (top eight scores; maximum of two gymnasts per national team); in C-III, value of the FS determines the gymnasts' rank. The findings of the present study [4] state that the above method of determining the FS may not be the most objective. The authors determine that the proportion between the Difficulty Score (DS) and ES, according to different formulas, can range from 17% to 67%. With the different proportions in the FS calculations, the number of changes in rankings is high: in C-I 81%, in C-II 61% and in C-III 35%. According to WAG CoP 2017-2020 [5], there are 5 groups of vaults which do not include an equal number of vaults within each group. From the total number of vaults in WAG (N=80), Group 1 includes 24 vaults (30%), Group 2 includes 14 vaults (17.5%), Group 3 includes 12 vaults (15%), Group 4 includes 19 vaults (75%), while Group 5 includes 11 vaults (13.75%; WAG CoP 2017-2020 version 1).

Naundorf, Brehmer, Knoll, Bronst and Wagner [6] determined that female gymnasts prefer the Yurchenko vaults. Considering the rules of WAG CoP 2013, but also the WAG CoP 2017 (which defines that in the Vault Qualifications and the Vault Finals gymnasts must perform two vaults that are from different groups and with different second-flight phases), there is a likelihood that the jumps from the other structural groups are/will be approximately equally represented at those competitions.

Regardless of the group to which the vault belongs, the judges evaluate only four phases of the vault: pre-flight, repulsion, after-flight and landing. In addition to deductions for errors in these phases of the vault performance, in 2009, the FIG introduced a deduction for landing in different places in or

outside the Corridor Line. This is the line in the middle of the mat that shows if a gymnast has landed on the spot that is centred with the vaulting table.

Research conducted on the quality of judging on the vault in the Men's Artistic Gymnastics (MAG) has determined that the vault is the most valuable apparatus for all-around gymnasts [7, 8, 9, 10, 11]. It is the easiest apparatus on which to obtain a high DS [12] and the highest ES [10].

Research conducted on the WAG has determined that the Vault and the Floor Finals are events with the highest scores and the lowest scores of dispersion; therefore, inspection of judging and future judging analyses have been suggested [13, 14]. Another WAG study analysed the differences between junior and senior competitors. It determined that senior gymnasts generally perform vaults better than junior gymnasts do. The authors attributed this to the increased anthropometric characteristics of the senior gymnasts compared to juniors [15].

Based on the empirical cognition, only a small number of female gymnasts compete and perform two (structurally different) vaults, which posed a problem for the authors of this paper. Accordingly, the main objectives of this research are: 1) to determine frequencies of the performed vaults, due to their vault group affiliation, at all major competitions from 2008 to 2016; 2) to determine the characteristics and development trends of the vault results at all major competitions from 2008 to 2016; 3) to analyse differences between values of the DS, ES and FS of the first and the second vaults performed during the Vault Finals.

Considering the fact that, throughout time, the vault experience has changed in its appearance and consequently in complexity of the performed vaults, the results of this study should be guidelines for female gymnasts who aspire toward the Vault Finals.

MATERIALS AND METHODS

SUBJECTS

The subject sample included all the elite senior female gymnasts who participated in C-III competitions at the Olympic Games in 2008, 2012 and 2016 (OG2008, OG2012, OG2016), at the World Championships in 2009, 2010, 2011, 2013, 2014 and 2015 (WC2009, WC2010, WC2011, WC2013, WC2014, WC2015) and at the Olympic Games qualifying tournament held in 2012 and 2016 (QOG2012, QOG2016).

VARIABLES

A variable sample is presented with a set of Difficulty Scores (DS), Execution Scores (ES) and Final Scores (FS) obtained for the performance of the first and the second vaults in the Vault Finals (C-III) competition retrieved from the specialized website for gymnastics results [16]. In previous studies, descriptive parameters [15, 17, 18] and generally satisfactory metric characteristics of those scores [7, 13, 14] have been presented.

STATISTICAL ANALYSIS

Data analysis included calculations of mean (M) ± standard deviations (SD). The significance of the differences between the observed frequencies of performed vaults was also presented. Data have been checked for univariate and multivariate outliers. None was found ($p > .05$). Due to the identification of the influence of factors, Competition (2008–2016) and Vaults (First Vault vs Second Vault) and their interaction on DS, ES and FS, 2×11 factorial ANOVA was applied together with Fisher LSD post hoc when needed. (Partial) η^2 was used for effect size assessment. Data was considered significant if ($p < .05$). All the calculations were performed using the Statistica 12.0 software package (StatSoft, Tulsa, OK, USA).

RESULTS

The vault numbers and their frequencies at the Vault Finals during all major competitions from 2008 to 2016 are shown in Figures 1 and 2.

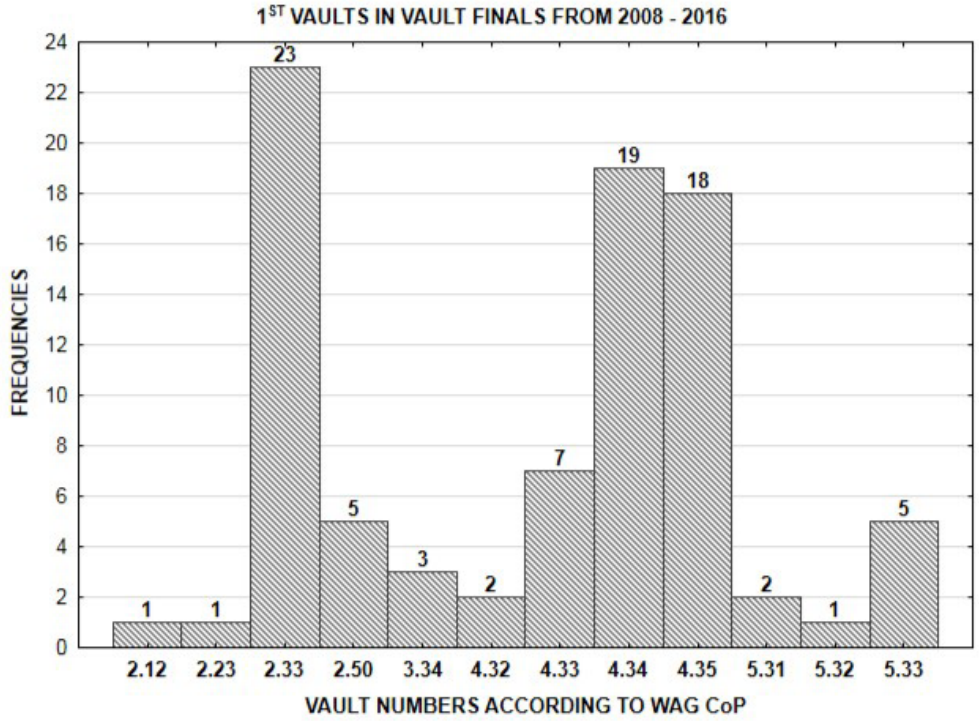

Fig. 1. First Vault – numbers and their frequencies at C-III competitions from 2008 to 2016

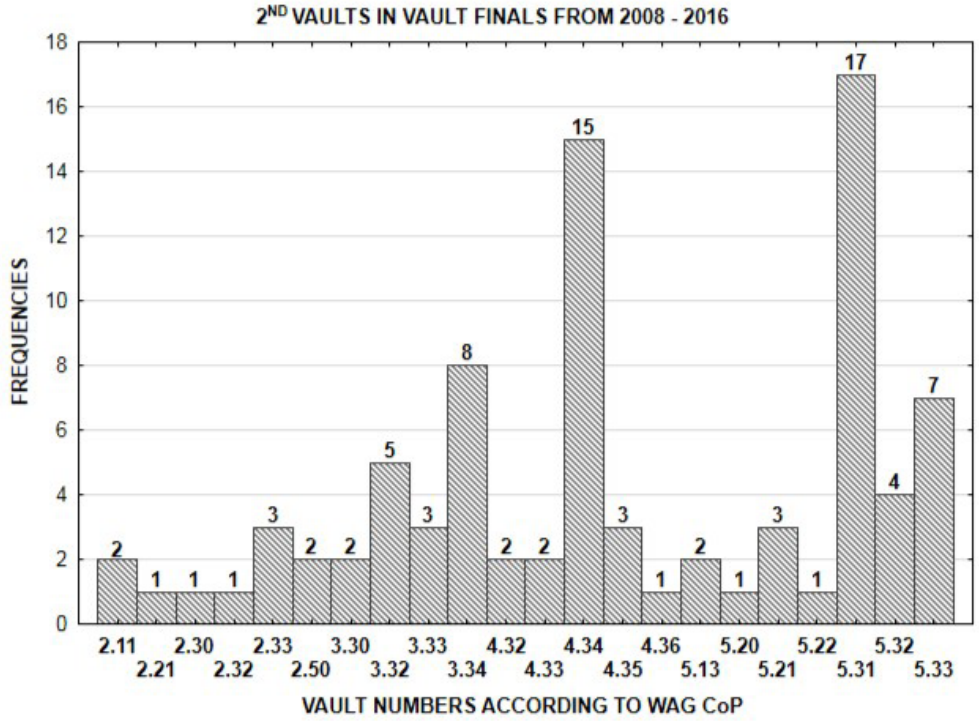

Fig. 2. Second Vault – numbers and their frequencies at C-III competitions from 2008 to 2016

Figures 1 and 2 indicate the preference of certain vaults by female vault finalists in the period from 2008 to 2016. The first-vaults with the highest frequencies were determined to be Handspring forward on – stretched salto forward with 1½ turn (540°) off (CoP number 2.33; N = 21), Round-off, flic-flac on – stretched salto backward with 1½ turn (540°) off (CoP number 4.34; N = 18) and Round-off, flic-flac on – stretched salto backward with 2½ turn (900°) off (CoP number 4.35; N = 16). The second vaults with the highest frequencies were determined to be Round-off, flic-flac with ½ turn (180°) on – salto forward stretched with ½ turn (180°) (CoP number 5.31; N = 15) and Round-off, flic-flac on – stretched salto backward with 1½ turn (540°) off (CoP number 4.34; N = 14). Other vaults were less frequent.

Descriptive parameters (mean ± standard deviations) of variables DS, ES and FS of the first and the second vaults during the Vault Finals, and the differences between those variables (determined at OG2008, WC2009, WC2010, WC2011, QOG2012, OG2012, WC2013, WC2014, WC2015, QOG2016, OG2016) are presented in Figures 3–5.

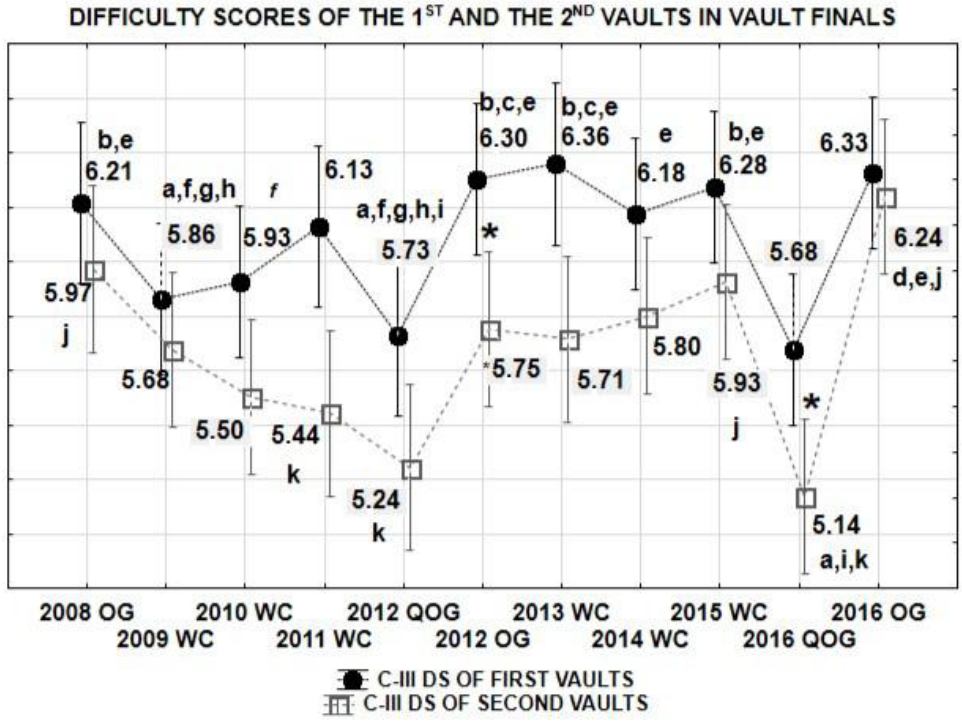

Fig. 3. Descriptive parameters of variables DS, ES and FS of the first and the second vaults during the Vault Finals, and the differences between those variables determined at OG2008, WC2009, WC2010, WC2011, QOG2012, OG2012, WC2013, WC2014, WC2015, QOG2016, OG2016

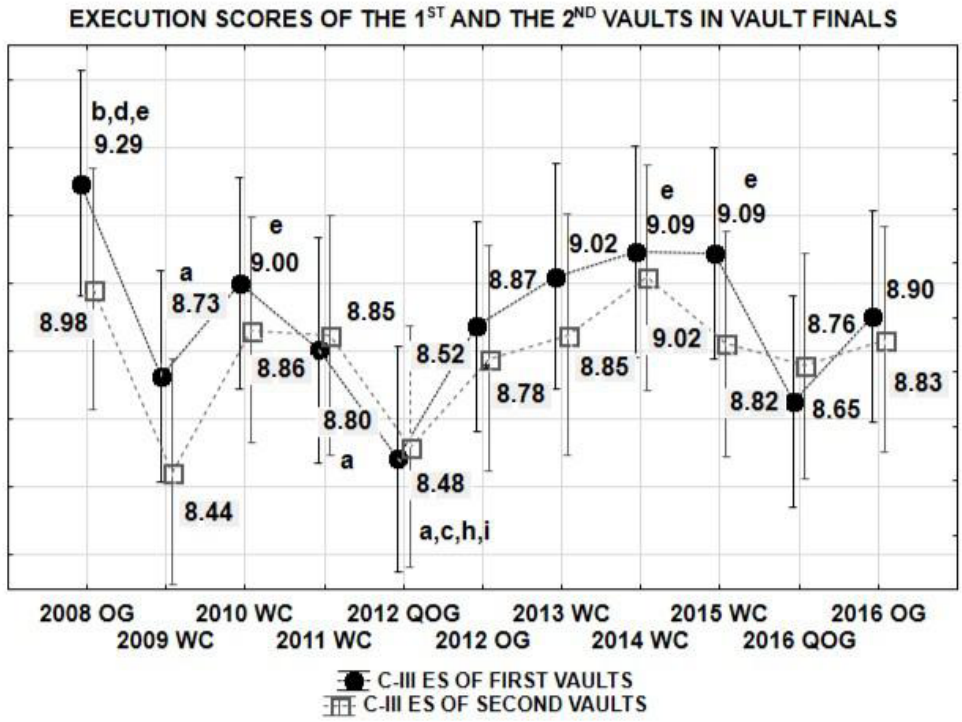

Fig. 4. Descriptive parameters of variables DS, ES and FS of the first and the second vaults during the Vault Finals, and the differences between those variables determined at OG2008, WC2009, WC2010, WC2011, QOG2012, OG2012, WC2013, WC2014, WC2015, QOG2016, OG2016

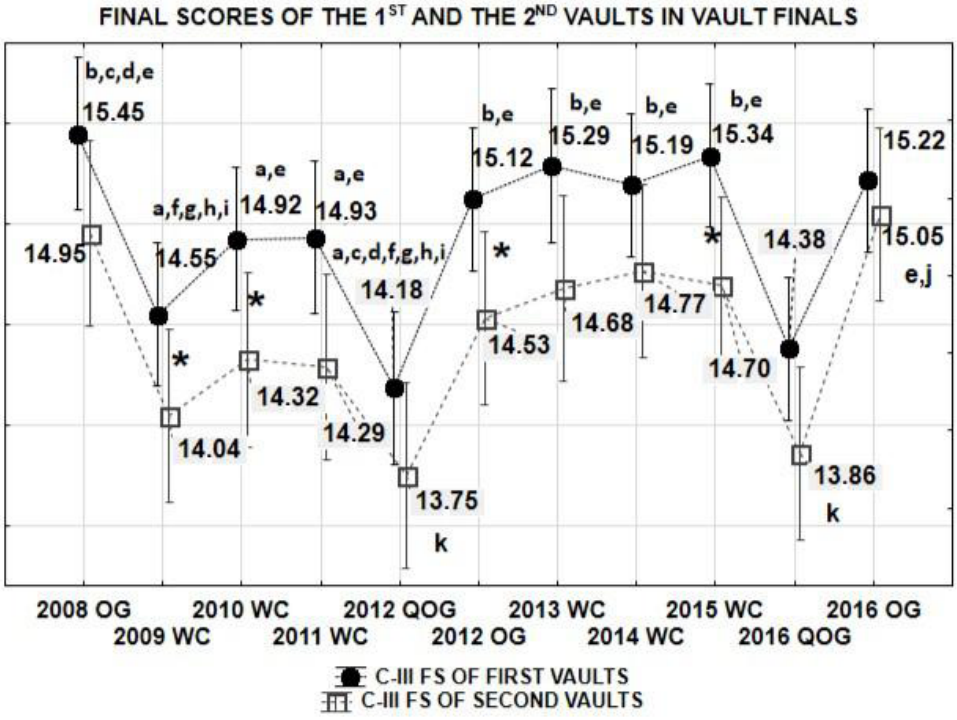

Fig. 5. Descriptive parameters of variables DS, ES and FS of the first and the second vaults during the Vault Finals, and the differences between those variables determined at OG2008, WC2009, WC2010, WC2011, QOG2012, OG2012, WC2013, WC2014, WC2015, QOG2016, OG2016

Regarding the first and the second vaults of the Vault Finals, the main effect of Competition was not found to be significant for the DS ($F_{10,73} = 5.10$; $p < .01$; $\eta^2 = .41$), ES ($F_{10,73} = 1.78$; $p = .08$; $\eta^2 = .20$) and for the FS($F_{10,73} = 5.29$; $p < .01$; $\eta^2 = .42$). The main effect of Vaults was significant for the DS ($F_{1,73} = 74.97$; $p < .01$; $\eta^2 = .51$), ES ($F_{1,73} = 4.60$; $p = .04$; $\eta^2 = .06$) and for the FS ($F_{1,73} = 84.70$; $p < .01$; $\eta^2 = .54$). Interaction Competition*Vaults appeared to be insignificant for the DS ($F_{10,73} = 1.40$; $p = .20$; $\eta^2 = .16$), ES ($F_{10,73} = .65$; $p = .77$; $\eta^2 = .08$) and for the FS ($F_{10,73} = .57$; $p = .83$; $\eta^2 = .07$).

For all scores of the first vaults, compared to all scores of the second vaults, a smaller range of the results has been determined:

1. $MaxVT1DS_{OG2012} - MinVT1DS_{QOG2012} =$
   0.57 vs $MaxVT2DS_{WC2015} - MinVT2DS_{WC2011} = 1.17$;
2. $MaxVT1ES_{OG2008} - MinVT1ES_{QOI2012} =$
   0.79 vs $MaxVT2ES_{WC2014} - MinVT1ES_{WC2011,WC2013} = 1.28$;
3. $MaxVT1TS_{OG2008} - MinVT1TS_{QOI2012} =$
   1.29 vs $MaxVT2TS_{WC2014} - MinVT1TS_{WC2011} = 2.27$.

DISCUSSION

Over the period from 2008 to 2016, female vaults have experienced improvement in complexity, especially of the second vaults. The findings illustrated in Figures 1 and 2 confirm the results of Naundorf, Brehmer, Knoll, Bronst and Wagner [6] with regard to which female gymnasts prefer the Yurchenko vaults. The same authors consider that some vaults should be temporarily omitted from

the CoP in order to prevent disinterest among gymnastics fans. However, we believe that applying of the new rules [3], which require gymnasts in the Vault Qualifications and the Vault Finals to perform two vaults that are from different groups and with different second-flight phases, achieve exactly the opposite effect. As one can see from the graphs, female gymnasts arbitrarily chose 12 different first vaults, and as many as 22 different second vaults in the Vault Finals. Consequently, the authors believe that the new rules facilitate the adoption of structurally complex vaults from different vault groups, which is why female Vault Qualifications and Vault Finals are becoming more interesting and competitive.

By analysing the trends of all scores (DS, ES and FS), it is evident that while the average values of all the scores at OG2008 decreased, all the scores at OG2012 had values that were equal or even higher than the scores at OG2008. After the OG2012, the values of the DS showed further increase (except in QOG2016): at the OG2016, their average values have been higher by 0.10 point (for the first vault), that is by 0.50 point higher (for the second vault) than the value at the OG2012. The same trend in the results has been determined for the scores ES and FS.

The determined reduction in average values of the DS, ES and FS between three observed OG could lead to the conclusion that the quality of the vault performance declined or that vaults with lower DV's were performed during this period. However, the malfunction of this conclusion can be justified by two facts: 1) the emergence of "new" female competitors after the OG2008 and OG2012, 2) through the changes in the CoP 2009 (compared to CoP 2005) and through changes in the CoP 2013 (compared to the CoP 2009).

It is well known that elite gymnasts generally begin their training at a very young age and many retire after competing at the Olympics only once in their career; female gymnasts retire before their twenties [19]. The same phenomenon probably happened after OG2008 and OG2012: "young" senior competitors made their first appearance in the next Olympic cycle (in the Olympic cycle 2009-2012 and in the Olympic cycle 2013–2016). If it is known that the biological maturation of female gymnasts is far behind that of the average population (review article [20]), and is correlated with the anthropometric measures and the motor skill status of female gymnasts, then we may assume that the biological status of "young seniors" may be a limiting factor in vault performances. Biological maturation and automatization of vault performances, by the end of the Olympic cycle at OG2012 and at OG2016, caused the execution of vaults with DVs equal to those performed in OG2008, that is at the OG2012.

DV values decreased in the three most frequently performed first vaults during the Vault Finals, from 2008 to 2016 (according to the CoP 2013, as compared to CoP 2009): 1) for Handspring forward on – stretched salto forward with 1½ turn (CoP number 2.33), DV decreased from 6.3 to 6.2; 2); for Round-off, flic-flac on – stretched salto backward with 1½ turn off (CoP number 4.34), DV decreased from 4.9 to 4.7; 3) and for Round-off, flic-flac on – stretched salto backward with 2½ turn off (CoP number 4.35), DV decreased from 6.5 to 6.3.

However, despite this, the values of DS for all competitions after OG2012 were numerically higher than the values of DS determined at the competitions before OG2012.

This confirms the empirical knowledge that each year female gymnasts perform vaults that are more difficult. Significant differences between the DS of the first and the second vault have been determined only for WC2010.

The identified similarities in the DS of the first and the second vaults are not surprising. On the contrary, they confirm the quality of female competitors in the Vault Finals. Non-differentiation between the values of the ES of the first and the second vault confirms that the best female vault competitors perform equally good vaults with different DV. Furthermore, the aforementioned finding imposes the conclusion that the introduction of the "Corridor rule" [3] did not have a significant impact on the ES during the Vault Finals.

Significant differences between the first and the second vault in the FS (at WC2009, WC2010, OG2012 and WC2015) are the result of certain facts and obtained results: 1) FS is a composite of the DS and ES; 2) at the analysed events, DS of the first vault on average accounted for 40.71% while ES of the first vault on average accounted for 59.29% of the FS of the first vault; 3) at the analysed events, DS of the second vault on average accounted for 39.27%, while ES of the second vault on average accounted for 60.83% of the FS of the second vault; 4) according to previous research, there is little discrimination between vault competitors in the DS; 5) the smallest variations among the judges' scores were determined during the Vault Finals [14]. Consequently, we may conclude that during the Vault Finals, the values of the ES are probably the main determinant of the vault finalists' rankings.

If we state that during the C-I competitions the first vault is counted in the All-Around Score and the Team Result, and the contestants usually perform their vaults in the same order, the obtained result is logical. Furthermore, higher variations determined for all scores of the second vault, compared to the variations of the first vault scores, lead to the conclusion that the stability of the performance of the female finalists' second vault is not equal to the stability of performance of the first vault.

CONCLUSIONS

Due to changes in rules of the Codes of Points, the sinusoidal trend of vault finals' result presents constant progress in the difficulty, quality and complexity of vaults in WAG in the period from 2008 to 2016.

The results also indicate that the performance of both vaults is of significant importance as vault performance is perceived as a full routine instead of two different skills, and if one is performed incorrectly, there is no possibility of making up the highest final score through the performance of the other vault.

Vaults from Group 4 have been determined to have the highest frequency for first vaults, while for second vaults, these were vaults from Group 5.

The above results have confirmed the preference for performing round-off

vaults in female gymnastics; the reasons for these unknown preferences should be investigated in future research.

In some competitions, numerically higher values of the DS and FS of the first vaults, compared to the DS of the second vaults, have been determined, while significant differences in the ES between the first and the second vaults have not been determined in any competitions.

Accordingly, due to a small discrimination between competitors in DS values, but also according to the percentage that the DS has in the FS, it was concluded that the scores of ES play an important role in the gymnasts' ultimate success during the Vault Finals.

The results of this study should be used for planning and programming training sessions of future generations of female gymnasts predisposed for the vault.

REFERENCES

[1] Čuk I, Karácsony I. Vault-methods, ideas, curiosities, history. Ljubljana: ŠTD Sangvinčki, 2004.

[2] Fédération Internationale de Gymnastique. 2009–2012 Code of Points Women's Artistic Gymnastics. [Available at: https://issuu.com/2008agwc/docs/01-1_wag_cop_2009-2012__english_] [Accessed on 15 February, 2017].

[3] Fédération Internationale de Gymnastique. 2013–2016 Code of Points Women's Artistic Gymnastics [Available at: https://www.yumpu.com/en/document/view/51423843/2013-2016-code-of-points-womens-artistic-gymnastics] [Accessed on 15 February, 2017].

[4] Čuk I, Fink H, Leskošek B. Modelling the final score in artistic gymnastics by different weights of difficulty and execution. Sci Gymnastics J. 2012;4(1):73-82.

[5] Fédération Internationale de Gymnastique. 2017–2020 Code of Points Women's Artistic Gymnastics, 2017. [Available at: http://www.fig-gymnastics.com/publicdir/rules/files/wag/CoP_WAG_2017-2020_ICI-e.pdf] [Accessed on 15 February, 2017].

[6] Naundorf F, Brehmer S, Knoll K, Bronst A, Wagner R. Development of the velocity for vault runs in artistic gymnastics from the last decade. In: Proceedings of 26th International Conference on Biomechanics in Sports. 2008; 481-484. [Available at: http://w4.ub.uni-konstanz.de/cpa/article/viewFile/1905/1774] [Accessed on 15 January, 2017].

[7] Leskošek B, Čuk I, Karácsony I, Pajek J, Bučar M. Reliability and validity of judging in men's artistic gymnastics at the 2009 University Games. Sci Gymnastics J. 2010;2(1):25-34.

[8] Bučar Pajek M, Forbes W, Pajek J, Leskošek B, Čuk I. Reliability of Real Time Judging System (RTJS). Sci Gymnastics J. 2011;3(2):47-54.

[9] Leskošek B, Čuk I, Pajek J, Forbes W, Bučar Pajek M. Bias of judging in men's artistic gymnastics at the European Championship 2011. Biol Sport, 2012;29(2):107-113.

[10] Atiković A, Delaš Kalinski S, Bijelić S, Avdibašić Vukadinović N. Analysis results judging world championships in men's artistic gymnastics in the London 2009 year. SportLogia. 2012;7(2):93-100.

[11] Perederij VV. The problem of the quality of judging in rhythmic gymnastics. Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports. 2013;3:43-46.

[12] Čuk I, Atiković A. Are disciplines in all-around men's artistic gymnastics equal? Sport Sci Pract Aspects. Int J Kinesiol. 2009;6(1&2):8-13.

[13] Bučar Pajek M, Čuk I, Pajek J, Kovač M, Leskošek B. Is the quality of judging in women artistic gymnastics equivalent at major competitions of different levels? J Hum Kinet. 2013;37(1):173-181.

[14] Bučar M, Čuk I, Pajek J, Karácsony I, Leskošek B. Reliability and validity of judging in women's artistic gymnastics at the University Games 2009. Eur J Sport Sci. 2012;12(3):207-215.

[15] Erceg T, Delaš Kalinski S, Milić M. The score differences between elite European junior and senior female gymnasts. Kinesiology. 2014;46(1):88-94.

[16] Gymnastics Results. [Available at: http://www.gymnasticsresults.com] [Accessed on 1 December, 2016].

[17] Massida M, Calo CM. Performance scores and standing during the 43rd Artistic Gymnastics World Championships, 2011. J Sports Sci. 2012;30(13):1415-1420.

[18] Leskošek B, Čuk I, Bučar Pajek M. Trends in E and D scores and their influence on final results of male gymnasts at European Championships 2005-2011. Sci Gymnastics J. 2013;5(1):29-38.

[19] Arkaiev LI, Suchilin NG. Gymnastics: How to create champions (2nd ed.). Aachen: Meyer & Meyer Sport Ltd; 2009.

[20] Malina RM, Baxter-Jones ADG, Armstrong N, et al. Role of intensive training in the growth and maturation of artistic gymnasts. Sports Med. 2013;43:783-802.

[21] Vault in the Proposed 2013–2016 Code of Points 2012. [Available at: https://betweentheolympics.wordpress.com/2012/04/02/vault-in-the-proposed-2013-2016-code-of-points/] [Accessed on15 January, 2017].

Cite this article as:
Delaš Kalinski S, Atiković A, Jelaska I. Challenges of female vault finals for the 2008–2016 period. Balt J Health Phys Act. 2017;9(4):55-65. doi: 10.29359/BJHPA.09.4.05