

Effect of serve quality on the rally outcome and course in women's top volleyball

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Abstract:

The aim of the study was to find out whether there is a relationship between the serve quality and the subsequent course of the rally in terms of successful or unsuccessful in the matches of the group phase of the 2019 Women's European Volleyball Championship. 15 matches in which 55 sets were played were analysed. To verify the relationships between variables, and to determine the degree of the dependence the χ^2 independence test and the normative contingency coefficient C_{nom} were used. The effect size for χ^2 - test was calculated by means of the coefficient r . The differences in the rally outcome in relation to the serve quality were tested with the test of difference between two relative values. The level of statistical significance was set at 5 %. A significant relationship between the serve quality and the outcome of the rally of the serving team ($\chi^2 = 66.23$; $p < 0.05$), and between the outcome of the rally on own serve and the number of ball crosses over the net ($\chi^2 = 93.51$; $p < 0.05$) were found. There were also significant differences in the serve quality in the winning and losing rallies in each evaluated quality level of the serve ($p < 0.05$). Anyway, the effect size showed a small effect in both investigated relationships, ($r = 0.10$, resp. 0.30). It turns out that the course of rallies is influenced by several other factors in addition to the serve quality. The results could contribute to a deeper understanding of the structure of the rallies and to the verification of serving strategies in women's top volleyball.

Key words: volleyball, service, rally outcome, net crossings, women

Introduction

The importance of the serve quality for the success in the match is known in today's top volleyball. There are several studies that have examined the effect of the serve on the final result of a volleyball set, resp. match, where in different contexts different tightness of this relationship in men's and women's volleyball was demonstrated (Přidal 2001, Häyrinen et al 2004, Marcelino et al 2008, Drikos et al 2009, Marcelino et al 2010, Quiroga et al 2010, Drikos & Vagenas 2011, Patsiaouras et al 2011, Rodríguez-Ruiz et al 2011, Přidal & Hančák 2012, Claver et al 2013, Silva et al 2014, Peña & Casals 2016, Valladares et al 2016, Alcaraz & Marcelino 2017, Přidal & Prikrelová 2018, Yonghui et al 2018, Klaričić et al 2018, Oliveira et al 2016 and 2018).

The relationship between the positions of players (setter, outside, middle, opposite player) in elite women's volleyball and the characteristics of the serve was analyzed by Quiroga et al. (2010). The most significant relationship observed was with the service area, primarily because the server has to move quickly to her defense zone. Setters and opposite players most commonly served from behind zone 1 (100 and 80% of serves, respectively), which they defended after serving. Similarly, middle players served most frequently from behind zone 5 (47% of serves), behind the zone they subsequently defended.

The aim of the Laios & Kountouris study (2011) was to examine whether the effectiveness of receiving and serving teams depend on the team's line-up resulting from the clockwise rotation of the players. The results showed that the team's rankings depend strongly on their serving and receiving efficiency. The rotation differs with regards to the efficiency of teams serving, but not with regards to the receiving efficiency. Most of the teams have one starting line-up with the setter in zone 1 when serving first and in zone 2 when receiving first. All teams used maximum of two preferred starting line-ups.

The study of Kountouris et al. (2015) is more closely related to our study. They found that the probability of winning the rally is mainly in favor of the receiving team (65% vs. 35%). Furthermore, the authors rightly state that the task of serving is not only to try to reach an ace, but especially to make it difficult to receiving team. Most players are thus willing to take risks at the serve even at the cost of a possible mistake, instead of giving the opponent a chance for a combination attack. Similar conclusions are given also by Marelič et al (2005).

According to Lopéz & Safont-Tria (2013), 5.9% of aces and 16.6% of errors were recorded in men's volleyball during the 2012 Olympics, but for women, 4.6% aces and only 7.8% errors. This significant difference in the number of errors is probably due to the different use of serve types. While in up to 75% of cases the jump

spin serve is used among men, in only 23.9% among women. According to the authors, the reasons are physical differences and requirements for performing an effective spike serve.

Titov& Steel (2019) analyzed the differences of the rallies in the relation to the serve quality in men's and women's category in Volleyball Nations League 2019 and compared them with the previous years. They came to several conclusions. Although the length of the rallies declined in women's volleyball for several years, they last longer than in men's volleyball, with or without "pseudo-rallies". If they also considered the mentioned "pseudo-rallies", e.g., rallies, where teams recorded an ace or a serve error, the difference was 1.48 s higher for women than for men. Excluding these rallies, the difference narrowed, but the rallies still lasted longer on average for women (8.31 s) than for men (7.10 s). Furthermore, in their study, they focused on the comparison of won rallies on own serve and on the serve of the opponent. Both sexes won more rallies on the opponent's serve (about 65% of men and 62% of women), which are similar results as reported Kountouris et al. (2015). However, inductive statistical methods were not used in this study.

The aim of our study was to determine the impact of the serve quality on the subsequent course of the rally in terms of its outcome (won/lost) in the matches of the group phase of the Women's European Volleyball Championship 2019. We assumed that there is a significant relationship between the serve quality and the outcome of rally on own serve, resp. between the course of the rally in terms of the number of ball crosses over the net.

Materials and Methods

The examined group consisted of 6 national teams, which played in pool D at the Women's European Volleyball Championship 2019. Together 15 matches and 55 sets were analyzed from videorecordings. The serves and rallies were analyzed from a quantitative and a qualitative point of view, specifically, the success of the serving team (won or lost rally), the quality of the serve and the number of ball crosses over the net in the rally (Table 1).

Table 1 5-level scale for evaluating the serve quality

Level 1	ace, point for the serving team
Level 2	effective serve, the opponent could attack under limited conditions after serve reception, an advantage for the serving team
Level 3	less effective serve, the opponent has more difficult conditions for running a combination attack
Level 4	ineffective serve, the opponent receives the serve excellently, disadvantage for the serving team
Level 5	erroneous serve, point for the opponent

Both extreme grades ace and erroneous serve (level 1 and 5) were excluded, as we wanted to analyze the course of the rallies, specifically the number of ball crosses over the net. The evaluation was defined as follows:

1 ball cross over the net

- erroneous attack of the receiving team
- the receiving team finalizes the rally with a successful attack

2 ball crosses over the net

- the receiving team covers its own attack and finalizes the course of rally with a successful, resp. unsuccessful attack
- the serving team defends the opponent's attack and successfully, resp. unsuccessfully counterattacks

3 ball crosses over the net

- the receiving team defends the counterattack of the serving team and successfully, resp. unsuccessfully attacks
- the counterattack of the serving team was blocked, serving team covers own attack and finalizes the rally with successful, resp. unsuccessful attack

4 and more ball crosses over the net

- the rally is not completed after the previous mentioned possibilities

To determine the reliability of the evaluation of examined variables (quality of serve and the number of ball crosses over the net) the Kendall coefficient of agreement (W) was used. In addition to the second author of the study, the randomly selected match was evaluated by two other experts (coaches of the highest qualification). A high reliability of the evaluation was detected in the case of the serve quality ($W = 0.8148$; $p < 0.05$), and also in the number of ball crosses over the net ($W = 0.9750$; $p < 0.05$).

To find out the relationship between the serve quality and other two variables and its degree the χ^2 - independence test for the contingency table and normalized contingency coefficient C_{nom} were used. When comparing the numbers of successful and unsuccessful rallies at particular serve quality levels, the test of the significance of the differences between the two relative values was used. The level of statistical significance was set at 5 %. The effect size for χ^2 - test was determined by means of the coefficient r , which determines the minimum degree of mutual relationship between the expected results and the findings (Rosenthal et al 2000).

Results

Frequency of the examined variables

In the monitored matches 1695 serves were registered. Of these, 325 rallies ended with an ace (level 1) or with a serving team's error (level 5). Specifically, only 8% of aces (direct points from serves) and 11% of erroneous serves were recorded. These are the types of rallies, which were not included in further analysis, as the rally was finalized after the serve. The most common serves in terms of their quality were ineffective serves (level 4), which accounted for 46% of all serves. In terms of relative countability this level was followed by less effective serves (level 3 - 37%) and effective serves (level 2 - 16%). We also determined the ratio between won and lost rallies of the serving team. The teams won more rallies after the opponent's service (57%) than after their own service (43%). From the point of view of the relative number of ball crosses over the net, we recorded the most rallies with one ball pass (52%). As the number of ball net crossings increased, their relative number decreased. Specifically, in the monitored matches, 19% were played with two ball crossings, 15% with three crossings and 13% with four or more crossings.

Relationship between the outcome of rallies on own service and the serve quality

In the relationship between the success of the serving team and the quality of the serve, we found a statistically significant relationship ($\chi^2 = 66.230$; $p \leq 0.05$). The magnitude of the calculated $C_{norm} = 0.304$ represents approximately 43% of the magnitude of C_{max} , indicating that the relationship between the success of the serving teaming the rally and the quality of the service is mediumly close.

In Figure 1, we see that in the won rallies of the serving team, less effective serve (38.4%) and ineffective serve (36.5%) occurred most often. Effective serve occurred in 25% of cases. The teams lost most of the rallies after the ineffective serve (53%). The number of less effective serves was comparable to that of the won rallies (36.4%). The importance of the serve quality was manifested by the lowest number of effective serves in the lost rallies on own serve (10.1%). Effect size, however, points to the small effect of the serve on the outcome the rally ($r = 0.2198$). When examining the significance of the differences between the two relative values, in our case the relative representation of won and lost rallies according to particular levels of serve quality, we found a significant difference ($p \leq 0.05$). The serving teams won the rally more often than it lost by both effective and less effective serve (grades 2 and 3) and contrarily, in ineffective serve (grade 4) lost more rallies (Figure 2).

Table 1 Relationship between the outcome of the rally on own serve and the serve quality

	Level 2	Level 3	Level 4	Total
Won rallies	147	226	215	588
Lost rallies	79	285	418	782
Total	226	511	633	1370
z-score	7,1427986*	0,7530273*	-6,326226*	
χ^2 - test	$\chi^2 = 66,230^*$; $C_{norm} = 0,304$			
Effect size	$r = 0,2198$			

* $p < 0,05$

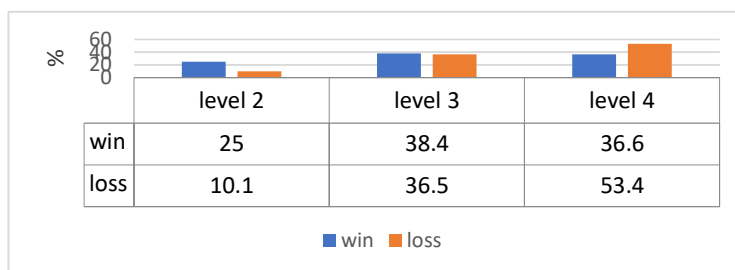


Figure 1 Relative frequency of serve quality levels in rallies won and lost on own service

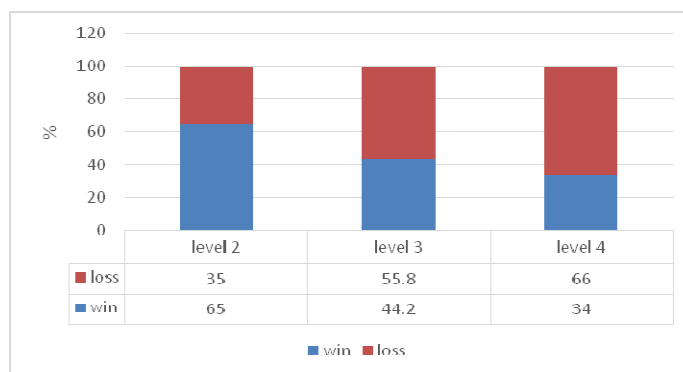


Figure 2 Relative ratio of won and lost rallies on own service according to qualitative serve levels

Relationship between the outcome of rallies on own service and the number of net crossings of the ball

The analyzed relationship was statistically significant ($\chi^2 = 93.510$; $p < 0.05$). Based on the calculated $C_{norm} = 0.358$, which represents approximately 51% of the magnitude of C_{max} , the relationship between the success of the serving team in the rally and the the number of net crossings is moderately tight. Effect size ($r = 0.2612$) indicates a small effect.

Most of the rallies were finalized after one net crossing, regardless of whether the serving team won (39.9%) or lost the rally (62%). These rallies were followed by rallies with two ball crossings over the net (almost 30%), then rallies with 4 or more ball crossings (15.9%) and finally rallies with three ball crossings (14.4%). The differences were more distinctive in the lost rallies on own serve. The serving team lost 62% of the rallies after having only one ball crossing over the net. This was followed by rallies with three ball crossings (15.5%), followed by two ball crossings (11.7%) and four or more ball crossings (11.2%).

Table 2 Relationship between the outcome of rally on own serve and the number of net crossings

	1 crossing	2 crossings	3 crossings	4 and more crossings	Total
Won rallies	236	176	85	94	591
Lost rallies	483	91	118	87	779
Total	719	267	203	181	1370
z- score	-8,292794*	8,2072904*	-0,396031*	2,518892*	
χ^2 - test	$\chi^2 = 93,510^*$; $C_{norm} = 0,358$				
Effect size	$r = 0,2233$				

* $p < 0,05$

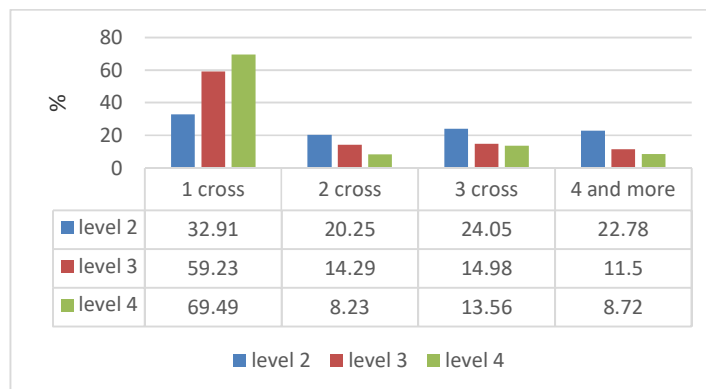


Figure 3 Relative frequency of net crossings in won and lost rallies on own serve

Discussion

It is important to state that the established fact about higher number of lost rallies on own serve (53%: 47%) may impact the team's serving strategy. Similar results reported also Titov and Steel (2019), who monitored and compared the results of the of men's and women's category in two following seasons. In both cases, the receiving team won more often the rally. For women, currently in the ratio of 58-63% to 42-37%. It turns out that in the current top women's volleyball, it is not an advantage to serve. This can often result in the basic game strategy of teams with a quality attack after serve reception (side out). They risk more on the serve. The teams are aware that in the case of an erroneous serve, there is a high probability that they win the next rally after the opponent's serve. Similar considerations for serving risk state also Kountouris et al. (2015).

It was no surprising to find out the most frequent course of the rally, where the rallies were finalized after the first attack of the receiving team (52%). It supports the importance of the team's performance after serve reception in terms of its success in the rally.

When examining the relationship between the success of the serving team in the rally and the serve quality, the results suggest a significant correlation. It is important for training practice that in the lost rallies there were the most ineffective and on the other side the least effective serves. In the won rallies on own serve, this ratio was more balanced. It turns out that the success of the team in the rally is determined not only by the serve quality, but also by other factors, especially by the quality of otherskills, such as attack and block. Here we can see one of the reasons for the smaller real significance of the serve to the team's success in the rally. The results of the significance of differences between the two relative values showed that effective and less effective serves likely affect the success in the rally of the serving team, and contrarily, with ineffective serve it is more likely that the serving team loses the rally.

We also found a significant relationship between the success of the serving team in the rally and the number of ball crossings over the net. In the rallies won by own serve, there was not such a significant difference

between the numbers of the ball net crossings, but on the contrary, in the lost rallies, the predominance of rallies with one net cross is visible. As we have already mentioned, even in the lost rallies on own serve, the largest proportion was in one ball net crossing, in up to 62% of cases. There were smaller differences in rallies with more than one net crossing. Low effect size of the influence of the number of ball net crossing on the success in the rally on own serve probably indicates that the course of the rally after reception attack (one net crossing) may be different. Various variables enter into this, such as favorable or unfavorable conditions for running an attack after defending the opponent's attack, the actual potential of attackers, the use of which influences above all the setter's decision how to solve the game situation. So, the next course of the rally is unpredictable and completely open.

Conclusions

The aim of the study was to determine the influence of the serve quality on the outcome and course of the rally in women's top volleyball. We found a significant relationship between the success of the serving team in the rally and the serve quality. On the other hand, the low effect size of this relationship points to the fact that the success of the serving team in the rally is influenced by a number of other factors. Another important result of our analysis was the finding that teams won fewer rallies when they served. In analyzed matches dominated the rallies which were finalized with the first attack of receiving team. Here, unambiguously, in the strategy of planning the content of training and subsequent offensive team's tactics, comes to the need to pay considerable attention to complex I, the game after serve reception (side out).

We also found a significant relationship between the rally outcome on own service and the number of ball crossings over the net. It turned out that the serving teams managed to both win and lose the most rallies after first net crossing of the ball. This is one evidence of the importance of the precise team's play after the opponent's serve.

In analyzed relationships, we found a small effect size. It should be noted that statistical significance is only a tool to facilitate the effect size. It follows from the above facts that the quality of the serve can affect the outcome and the course of the rally but in addition several other variables enter into the course of the rally. Predicting the outcome of the rally and its course based on the evaluation of the serve quality is just one of the ways to find the factors that influence the success of the team in the rally and in the final effect in the whole match.

References:

- Alcaraz, A.G. & Marcelino, R. (2017). Influence of match quality on men's volleyball performance at different competition levels, *International Journal of Performance Analysis in Sport*, 17(4), 394-405.
- ClaverRabaz, F., Jiménez Castuera, R., Gil Arias, A., Moreno Domínguez, A. & Moreno Arroyo, M. (2013). Relationship between performance in game actions and thematchresult. A study in volleyballtrainingstages. *Journal of Human Sport and Exercise -University of Alicante*, 8(3), 651-659.
- Drikos, S., Kountouris, P., Laios A. & Y. Laios, (2009). Correlates of Team Performance and the match result in Volleyball. A study in volleyball training stages. *International Journal of Performance Analysis of Sport, Cyncoed*, 9(2), 149-156.
- Drikos, S. & Vagenas, G. (2011). Multivariate assessment of selected performance indicators in relation to the type and result of a typical set in Men's Elite Volleyball. *International Journal of Performance Analysis in Sport* 11(1), 85-95.
- Häyrinen, M., Hoivala, T., & Blomqvist, M. (2004). Differences between winning and losing teams in men's European top-level volleyball. [online]. Belfast: St. Mary's University College, 168-177. Website: http://energia.kihu.jyu.fi/tuotostiedostot/julkinen/2004_hay_difference_10001.pdf
- Klaričić, I., Grgantov, Z. & Jelaska, I. (2018). Prediction of efficiency in elite volleyball: Multiple regression approach. *Acta Kinesiológica* 12 (1), 79- 85.
- Kountairis, P., Drikos, Aggelonidis S.I. & Laios, A. (2015). Evidence for differences in men's and women's volleyball games based on skill effectiveness in four consecutive Olympic tournaments. *Faculty of physical education and sports science, University of Athens. in Comprehensive psychology*, 4(9), ISSN 2165-2228.
- Laios, A. & Kountouris, P. (2011). Receiving and serving team efficiency in Volleyball in relation to team rotation. *International Journal of Performance Analysis in Sport Volume 11(3)*, 553-561.
- López, J. P. & Safont-Tria, B.B. (2013). Analysis of the service as a performance factor in high-level volleyball and beach volleyball. [online]. https://www.researchgate.net/publication/336650070_analysis_of_the_service_as_a_performance_factor_in_high-level_volleyball_and_beach_volleyball
- Marcelino, R., Mesquita, I., & Afonso, J. (2008). The weight of terminal actions in volleyball. Contributions of the spike, serve and block for the teams' rankings in the World League 2005. *International Journal of Performance Analysis In Sport*, 8(2), 1-7.
- Marcelino, R., Mesquita, I., Sampaio, J. & Moraes, J.C. (2010). Study of performance indicators in male volleyball according to the set results. *Brazilian Journal of Physical Education and Sport*, 24(1), 69-78.

- Marelić, N., Rešetar, T., Zdražnik, M., & Đurković, T. (2005). Modelling of situation parameters in top level volleyball. In D. Milanović, & F. Prot (Eds.), Proceedings Book of 4th International Scientific Conference, Opatija, 2005, „Science and Profession –Challenge for the Future“ (pp. 459-462). Zagreb: Faculty of Kinesiology, University of Zagreb.
- Oliveira, A., Vaz, L., Pastore, J.C., & Joao, P. (2018). Discriminate Scoring Skills and Non-Scoring Skills According to Results in the Brazilian Men's Volleyball SuperLeague. *Montenegrin Journal of Sports Science and Medicine*, 7(1), 73-79.26.
- Oliveira, A., Valladares Iglesias, N., Vaz, L., & Joao, P. (2016). Evaluation of Scoring Skills and Non Scoring Skills in the Brazilian SuperLeague Women's Volleyball. *Montenegrin Journal of Sports Science and Medicine*, 5(2), 25-31.
- Quiroga, M.E., Garcia-Manso, J.M., Rodrigues-Ruiz, D., Sarmiento, S., De Saa, Y. & M. P. Moreno, M.P. (2010). Relation between in-game role and service characteristics in elite women's volleyball, *Journal of Strength and Conditioning Research* 24(9)/2316–2321.
- Patsiaouras, A., Moustakidis, A. Charitonidis, K. & Kokaridas, D. (2010). Volleyball technical skills as winning and qualification factors during the Olympic Games 2008. *International Journal of Performance Analysis in Sport*, 10(2), 115-120.
- Peña, J. & Casals, M. (2016) Game-Related Performance Factors in four European Men's Professional Volleyball Championships. *Journal of Human Kinetics* 53(1) 223-230
- Přidal, V. (2001). Dependence of team success on quantitative and qualitative characteristics of skills in volleyball. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, 42(1), 5-55. ISBN 80-223-1694-6 (Published in Slovak language).
- Přidal V. & Hančák, J. (2012). Effects of the quality of selected kinds of game skills of an individual on the set outcome in men's top-level volleyball. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, 52(1), 49–60.
- Přidal, V. & Prikrelova, S. (2018). Analysis of relation between team placing in tournament and selected indicators of playing performance in top-level volleyball. *Journal of Physical Education and Sport*, 18(3), 1501-1505.
- Silva, M., Lacerda, D., João, P.V. (2014). Game-Related Volleyball Skills that Influence Victory. *Journal of Human Kinetics volume 41*, 173-179
- Rodríguez-Ruiz, D., Quiroga, M., Miralles, J. Sarmiento, S., Saá, Y. & García-Mans, J. (2011), Study of the technical and tactical variables determining set win or loss in top level European men's volleyball. *International Journal of Performance Analysis in Sport*, 7 (1), 1-15.
- Rosenthal, R., Rosnow, R. L., & Rubin, D. B. (2000). Contrasts and effect sizes in behavioral research: A correlational approach. Cambridge: Cambridge university press.
- Titov, S. & Steel, S. (2019). Picture of the game (annual report). *FIVB, Scientific research project*. [online]. <https://www.fivb.com/-/media/2020/fivb-corporate/volleyball/rules-of-the-game/72019pictureofthegamereport--final-version.pdf?la=en>
- Valladares, N., García-Tormo, J.V. & João, P.V. (2016). Analysis of variables affecting performance in senior female volleyball World Championship 2014. *International Journal of Performance Analysis in Sport*, 16 (1), 401-410.
- Yonghui, Y., de Alcaraz, A.G., Wang, L. & Liu, T. (2018). Analysis of winning determinant performance indicators according to teams' level in Chinese women's volleyball. *International Journal of Performance Analysis in Sport Volume 18*(5), 750-763.