SERVICE EFFICIENCY INDEX ANALYSIS FOR ROMANIAN MEN'S VOLLEYBALL TEAMS IN DIVISION A1, 2019-2020 SEASON

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Abstract. *The purpose of this study is to analyse and highlight the service efficiency indices for Romanian men's volleyball teams in Division A1 during the 2019-2020 competition season. The research is based on the hypothesis according to which there are statistically significant differences in service efficiency indices between men's volleyball teams participating in the Romanian Division A1 during the 2019-2020 season. In this study, we analysed 10 men's volleyball teams in Division 1, more precisely, 104 players who performed 15,782 services in the 2019-2020 season. In order to statistically analyse the data collected from official games, the One-Way ANOVA test in SPSS was used, and the results indicated that there were statistically significant average differences between the analysed teams as regards their service efficiency indices (F (9.94) = 2.648, P = .009). The results obtained showed that the service efficiency indices depended on the value of players and teams participating in the Romanian Division A1 throughout the 2019-2020 season. Following the analysis of the assessment indices, we concluded that the service efficiency indices for men's volleyball teams participating in the Romanian Division A1 during the 2019-2020 competition season differed from one team to another, and the differences were statistically significant.*

Keywords: *efficiency, service, men's volleyball.*

Introduction

Volleyball is different from other team games because it is a sport with multiple actions following "a cyclic and sequential pattern" (Beal, 1989, p. 336). In top-level sport, teams must have control of the game components in order to avoid interrupting the sequence "while trying to get their opponents to do it" (Palao et al., 2004, p. 50).

A volleyball match includes different specific technical executions, namely "serve, reception, set, attack, block, and defence" (Inkinen et al., 2013, p. 43) as basic actions that can be technically performed in various ways.

Volleyball incorporates two game stages: Side-out (or Complex I), which consists of reception, setting and attack, and Counter-attack (or Complex II), which is composed of service, block, dig, setting and attack (Hilena et al., 2020; Laporta et al., 2015; Silva et al., 2014; Palao et al., 2004). According to Peña and Casals (2016), the most important factor to score points when playing in Complex I (attack phase) is "a direct point from the first attack after reception" (p. 223), while in Complex II (or counter-attack phase), the best predictors are "direct points coming from a service (aces) and direct points coming from attack actions" (p. 224). In a careful analysis of the success in Complex I (or Side-out), Palao (2018) shows that this is composed of the opponent's error in service, the side-out point (first attack), the counter-attack point (attack and block) and the opponent's errors, and the success in Complex

II (or Counter-attack) is composed of the points in service, the opponent's error in the side-out (first attack), the counter-attack point (attack and block) and the opponent's errors.

According to the study by Marcelino et al. (2010), the teams that win their sets show "a more balanced distribution of points earned between the three terminal actions (attack, block and service) than the teams that lose their sets" (p. 69). The author states that attack, block and service actions allow to score a direct point (being called Scoring Skills), while defence, setting and reception actions can contribute less to scoring (which is why they are termed Non Scoring Skills). Silva et al. (2014) believe that "the block is the first terminal action that the opposition may take to the opponent's attack, and may result in a direct point" (p. 177).

Some authors (Castro et al., 2011; Silva et al., 2014) have found that successful service points are likely to be associated with top results in competitions, while Laios and Kountouris (2011) showed that the ranking of men's teams in the Greek Division A1 during the 2005-2006 season was strongly determined by their serving and passing efficiency, given that the balance between serving and receiving is an important feature of a successful team. The service is considered to be the first attack weapon in the arsenal of elite teams because it has a clear offensive purpose (Deprá et al., 1998; Quiroga et al., 2010; MacKenzie et al., 2012). In elite volleyball, the balance between service and dig leans towards the service (Palao, 2018; Szabo et al., 2019).

The service has a great importance in men's international top volleyball (Häyrinen et al., 2009) where it becomes a powerful offensive tool used to score points directly or to assist the block or transition attack in order to score points (Palao et al., 2004; Zetou et al., 2006).

Borrie et al. (2002) believe that the coach's observation is an important factor in designing training plans and monitoring both the training process and sports competitions. However, given that the observation method is subjective and therefore less valid and credible (Ciemiński, 2018), modern statistical methods related to team sports seem to be very useful in improving the quality of analysis (Sampaio et al., 2004).

The data collected through the study conducted by Quiroga et al. (2010) show that, when players are trained to receive, coaches should consider using a wide range of services during training, focusing on the service type and area, the zone where the receiving player will move and the speed of delivery. The main goal of serving is to score a point (ace) or make the opposing team's reception and attack as difficult as possible (Masumura et al., 2007).

Moras et al. (2008) classified the serves into three types (according to the techniques used) as follows: float serve (the player hits the ball with no spin while standing with both feet on the floor), float serve with jump (the player jumps to meet the ball in the air and abruptly stops it without letting it spin; a float effect is thus created by keeping the ball from spinning) and jump serve (the player jumps to meet the ball in the air with much pace and topspin and performs a spike); the above authors "found a greater predominance of jump serve in high-level volleyball" (p. 34).

In the opinion of Marelič et al. (2005), top volleyball players should take more risk in the service in order to try to neutralise the opposing team's strong attack and increase their own chances of success in the block.

There are four main characteristics of a serve that determine the difficulty level for the receiving team: ball speed (Strohmeyer, 1996), flight time (Katsikadelli, 1996), predictability of the trajectory and player's ability to conceal the type of serve (Deprá et al., 1998).

Considering the above aspects, the *purpose* of this study was to analyse and highlight the service efficiency indices in Romanian men's volleyball, because serving is a very important game action at elite level for achieving top results in official competitions, and its efficiency contributed to team success in Division A1 during the 2019-2020 season.

Methodology

The present study included 10 Romanian men's teams participating in the National Volleyball Championship, Division A1, during the 2019-2020 season. Our analysis focused on the service performed by 104 volleyball players who competed in at least three matches and had a ratio of at least 1 service per set. The athletes were represented as follows: 13 players each from the CSM Arcada Galați and CS Unirea Dej teams; 11 players each from the CS Dinamo Bucharest, ACS Volei Municipal Zalău and CS Știința Explorări Baia Mare teams; 10 players each from the SCM U Craiova and CSM Gloria Buzău teams; 9 players each from the CS UV Timișoara and CSM Câmpia Turzii teams; 7 players from the CS "U" Cluj team. These players performed 15,782 services that we analysed and for which we calculated the efficiency indices in order to verify the *hypothesis* according to which "there are statistically significant differences in service efficiency indices between men's volleyball teams participating in the Romanian Division A1 during the 2019-2020 season".

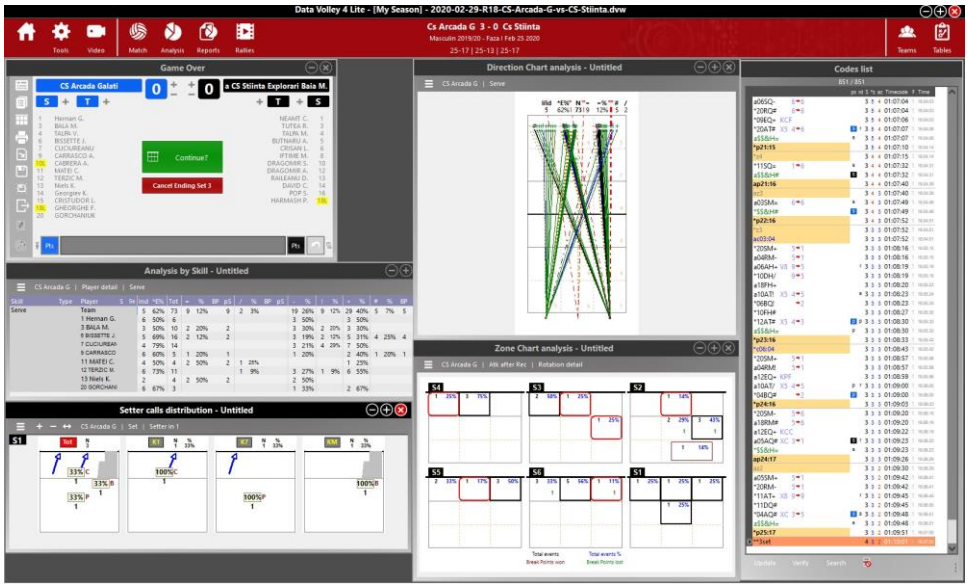
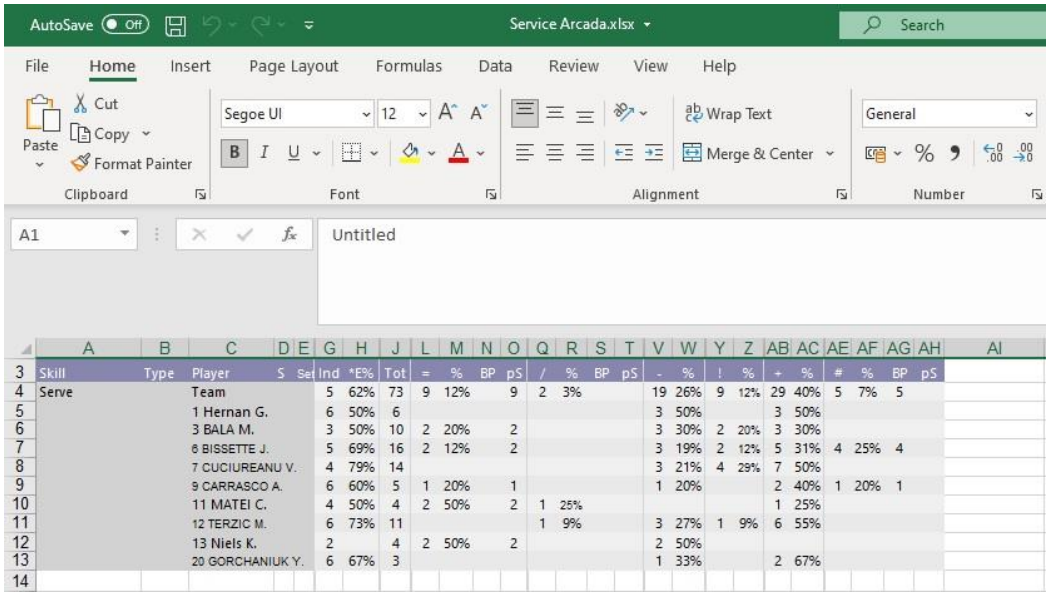


Figure 1. Data Volley statistical program

In order to calculate the service efficiency indices, we collected the necessary data with the help of the Data Volley statistical program (Figure 1), which is currently the most used statistical analysis program for top-level volleyball teams. We could thus analyse the game in technical and tactical terms according to the players, game actions (service, dig, pass, attack, block, setting, free ball), action efficiency (on 6 coding levels), direction of action (area to which the service and attack balls were headed), distribution of passes made during the game (on rotations) and tactical attack combinations (setter calls).



Skill	Type	Player	S	Set	Ind	*E%	Tot	=	%	BP	pS	/	%	BP	pS	-	%	!	%	+	%	#	%	BP	pS
Serve		Team			5	62%	73	9	12%		9	2	3%			19	26%	9	12%	29	40%	5	7%	5	
		1 Hernan G.			6	50%	6									3	50%			3	50%				
		3 BALA M.			3	50%	10	2	20%		2					3	30%	2	20%	3	30%				
		6 BISSETTE J.			5	69%	16	2	12%		2					3	19%	2	12%	5	31%	4	25%	4	
		7 CUCIUREANU V.			4	79%	14									3	21%	4	29%	7	50%				
		9 CARRASCO A.			6	60%	5	1	20%		1					1	20%			2	40%	1	20%	1	
		11 MATEI C.			4	50%	4	2	50%		2	1	25%							1	25%				
		12 TERZIC M.			6	73%	11					1	9%			3	27%	1	9%	6	55%				
		13 Niels K.			2		4	2	50%		2					2	50%								
		20 GORCHANIUK Y.			6	67%	3									1	33%			2	67%				

Figure 2. Data export from the Data Volley statistical program

After creating the database using the Data Volley statistical program, we exported the recorded data into Microsoft Excel (Figure 2) where we calculated the service efficiency with the help of the following formula (Voinea & Rață, 2020):

$$E = \frac{(A + B * 0.8 + C * 0.6 + D * 0.4 + E * 0.2)}{(A + B + C + D + E + F)}$$

where:

- A - represents a serve point of 5 points - whose value is 1;
- B - represents a half-ace serve of 4 points - whose value is 0.80;
- C - represents a positive serve of 3 points - whose value is 0.60;
- D - represents a neutral serve of 2 points - whose value is 0.40;
- E - represents a negative serve of 1 point - whose value is 0.20;
- F - represents a wrong serve of 0 points - which has no value.

The six-level scaling and coding used for the service game action are as follows:

- 0: "=" = *Foul* (into the net, outside the playing field, stepping on the bottom line)
- 1: "-" = *Negative* (the opponent's reception is "#" or "+" and he can attack with all options)
- 2: "!" = *Neutral* (the opponent's reception is "!" and the ball is taken over on the 3-meter line)
- 3: "+" = *Positive* (the opponent's reception is "-" and he can only be attacked from high pass)
- 4: "/" = *Half ace* (the opponent's reception is weak and the ball is sent directly to their field)
- 5: "#" = *Direct point* (the opponent's reception is foul "=")

All the results were obtained from the official matches played by men's volleyball teams participating in the Romanian Division A1 in the 2019-2020 competition season (between October 2019 and March 2020).

In the statistical analysis of results, we first used the Shapiro-Wilk test to see whether the recorded data had a normal distribution for each team. We then used the One-Way ANOVA test to calculate whether there were statistically significant differences in service efficiency indices between the teams participating in our study. After that, we used the nonparametric Kruskal-Wallis test to see whether the distribution of service efficiency indices was the same for men's volleyball teams in the Romanian Division A1 during the 2019-2020 season. For all these statistical tests, we used the SPSS program (version 20, IBM) with a significance level set at $\alpha = .05$.

Results

In order to see whether the service efficiency indices of the teams participating in our research were normally distributed, we used the Shapiro-Wilk test, and the results obtained are shown in Table 1 and Figure 3.

Table 1. *Normality test for the distribution of efficiency indices per team*

Team	Shapiro-Wilk		
	Statistical	Df	Sig.
CSM Arcada Galați	.912	13	.193
SCM U Craiova	.934	10	.491
CSU UV Timișoara	.944	9	.625
CSM Câmpia Turzii	.885	9	.177
CS Dinamo Bucharest	.901	11	.192
CS "U" Cluj	.947	7	.701
CS Unirea Dej	.936	13	.412
ACS Volei Municipal Zalău	.889	11	.134
CS Știința Explorări Baia Mare	.820	11	.017
CSM Gloria Buzău	.958	10	.768

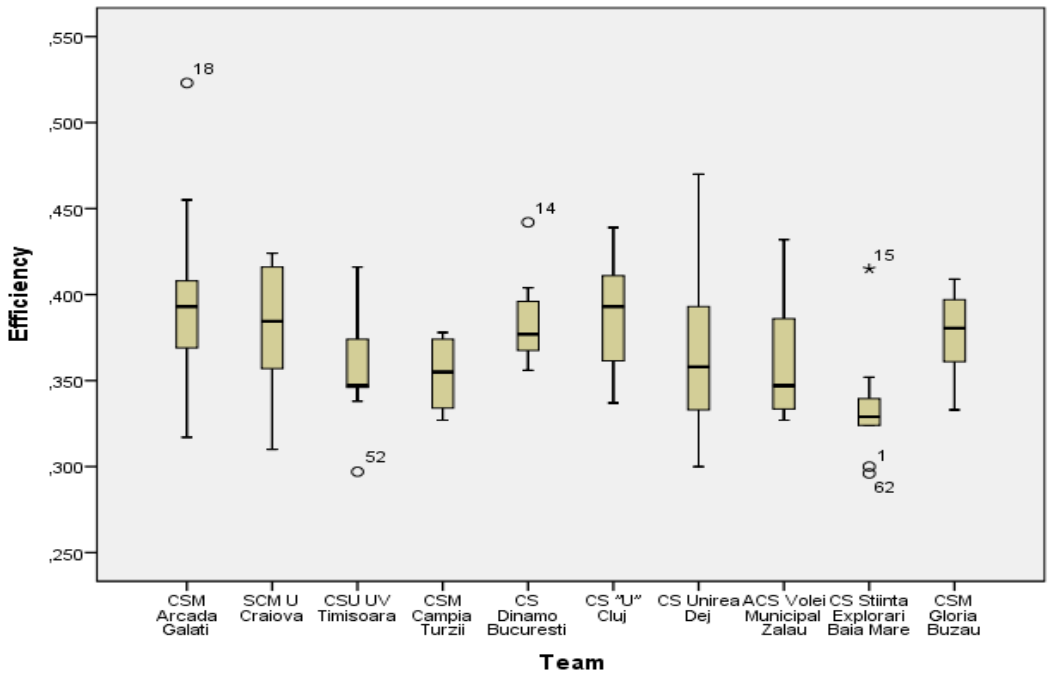


Figure 3. Normality test for the distribution of efficiency indices per team

Analysing the data obtained from the Shapiro-Wilk test (Table 1), we can notice that they are normally distributed for most teams participating in the study; the only team for which the data are not normally distributed is CS Știința Explorări Baia Mare.

After finding that most of the data related to service efficiency indices were normally distributed for the participating teams, we continued the statistical analysis using the SPSS program with which we performed the descriptive statistics of our data on service efficiency indices for the studied teams: number of cases, arithmetic mean, standard deviation, standard mean error, 95% confidence interval for the mean, minimum and maximum mean values (Table 2).

Table 2. *Descriptive statistics of service efficiency indices per team*

Team	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
CSM Arcada Galați	13	. 394	. 053	. 014	. 361	. 426	. 317	. 523
SCM U Craiova	10	. 381	. 037	. 011	. 354	. 407	. 310	. 424
CSU UV Timișoara	9	. 359	. 036	. 012	. 331	. 387	. 297	. 416
CSM Câmpia Turzii	9	. 355	. 020	. 006	. 339	. 370	. 327	. 378
CS Dinamo Bucharest	11	. 383	. 024	. 007	. 367	. 400	. 356	. 442
CS "U" Cluj	7	. 387	. 037	. 014	. 352	. 422	. 337	. 439
CS Unirea Dej	13	. 362	. 046	. 013	. 334	. 391	. 300	. 470
ACS Volei Municipal Zalău	11	. 362	. 035	. 010	. 338	. 385	. 327	. 432
CS Știința Explorări Baia Mare	11	. 333	. 031	. 009	. 312	. 355	. 296	. 415
CSM Gloria Buzău	10	. 378	. 023	. 007	. 362	. 395	. 333	. 409
Total	104	. 369	. 039	. 003	. 362	. 377	. 296	. 523

Analysing the data presented in Table 2, we can notice that the service of men's volleyball teams in the Romanian Division A1 during the 2019-2020 season has an average efficiency index of .369 with a standard deviation of .039, a standard mean error of .003, a minimum value of .296 and a maximum value of .523.

If we analyse each team's service efficiency, we find the following indices for men's volleyball teams in the Romanian Division A1 during the 2019-2020 season:

- The CSM Arcada Galați team achieved an average value of service efficiency indices of .394 with a standard deviation of .053, a standard mean error of .014, a minimum value of .317 and a maximum value of .523.
- The SCM U Craiova team achieved an average value of service efficiency indices of .381 with a standard deviation of .037, a standard mean error of .011, a minimum value of .310 and a maximum value of .424.
- The CSU UV Timișoara team achieved an average value of service efficiency indices of .359 with a standard deviation of .036, a standard mean error of .012, a minimum value of .297 and a maximum value of .416.
- The CSM Câmpia Turzii team achieved an average value of service efficiency indices of .355 with a standard deviation of .020, a standard mean error of .006, a minimum value of .327 and a maximum value of .378.

- The CS Dinamo Bucharest team achieved an average value of service efficiency indices of .383 with a standard deviation of .024, a standard mean error of .007, a minimum value of .356 and a maximum value of .442.
- The CS "U" Cluj team achieved an average value of service efficiency indices of .387 with a standard deviation of .037, a standard mean error of .014, a minimum value of .337 and a maximum value of .439.
- The CS Unirea Dej team achieved an average value of service efficiency indices of .362 with a standard deviation of .046, a standard mean error of .013, a minimum value of .300 and a maximum value of .470.
- The ACS Volei Municipal Zalău team achieved an average value of service efficiency indices of .362 with a standard deviation of .035, a standard mean error of .010, a minimum value of .327 and a maximum value of .432.
- The CS Știința Explorări Baia Mare team achieved an average value of service efficiency indices of .333 with a standard deviation of .031, a standard mean error of .009, a minimum value of .296 and a maximum value of .415.
- The CSM Gloria Buzău team achieved an average value of service efficiency indices of .378 with a standard deviation of .023, a standard mean error of .007, a minimum value of .333 and a maximum value of .409.

Continuing the analysis of the data shown in Table 2 and Figure 4, we can observe that the CSM Arcada Galați team had the highest mean of the service efficiency index with a value of .394, while the CS Știința Explorări Baia Mare team had the lowest mean of the service efficiency index with a value of .333.

The following teams achieved better average values of service efficiency indices than the average of men's volleyball teams in the Romanian Division A1 during the 2019-2020 season: CSM Arcada Galați, CS "U" Cluj, CS Dinamo Bucharest, SCM U Craiova and CSM Gloria Buzău, while CS Unirea Dej, ACS Volei Municipal Zalău, CSU UV Timișoara, CSM Câmpia Turzii and CS Știința Explorări Baia Mare achieved lower average values of service efficiency indices than the championship average.

The lowest mean of service efficiency indices throughout the championship was recorded by the CS Știința Explorări Baia Mare team with a value of .296, and the highest mean was obtained by the CSM Arcada Galați team with a value of .523.

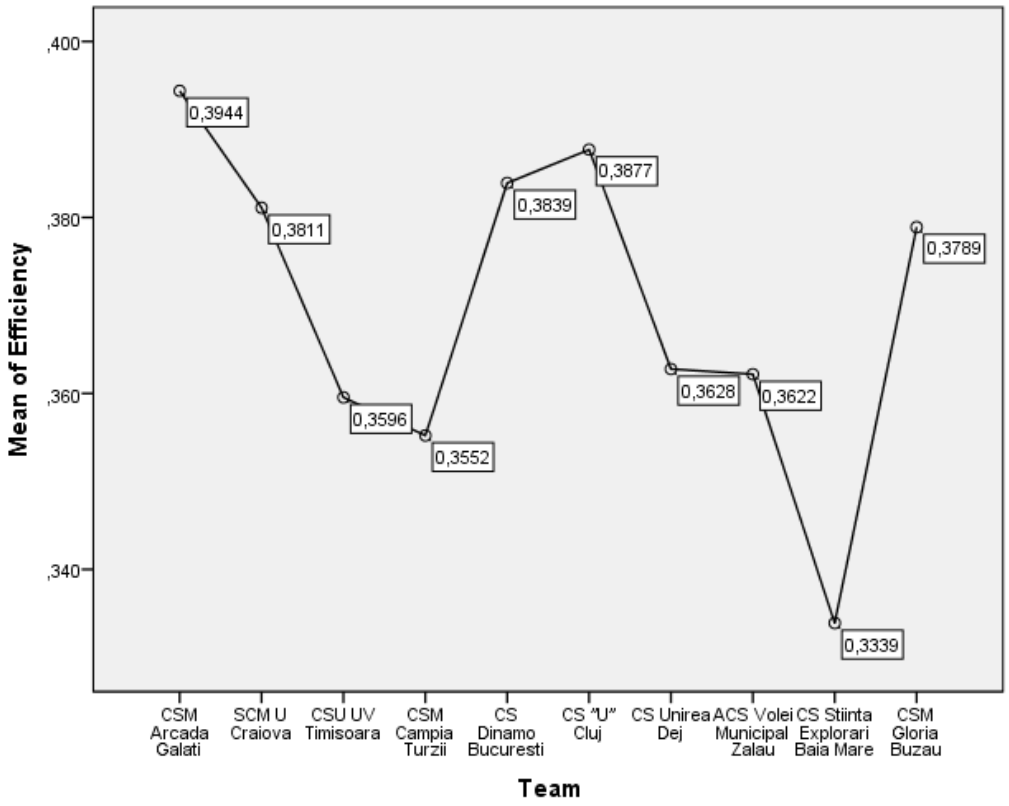


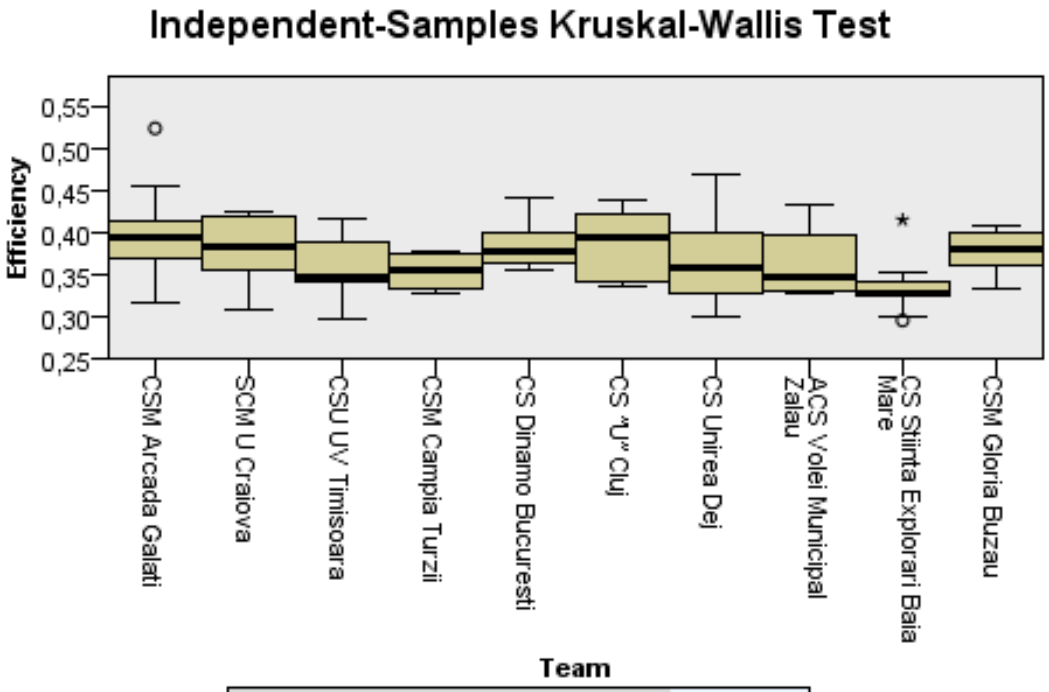
Figure 4. Average values of service efficiency indices per team

To see whether the research hypothesis was confirmed, we continued the analysis with the One-Way ANOVA test using the SPSS program to highlight possible statistically significant differences in service efficiency indices between the teams participating in the study. Thus, Table 3 shows the results of this test for the studied men's volleyball teams in terms of service efficiency indices achieved in the official games played during the 2019-2020 season by the Romanian Division A1. Data analysis reveals that "there are statistically significant differences in service efficiency indices between men's volleyball teams participating in the Romanian Division A1 during the 2019-2020 season", which suggests that the service is the first attack weapon in top-level volleyball, with F (9.94) = 2.648, P = .009.

Table 3. *One-Way ANOVA test results for all teams (P < .05)*

Efficiency	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.033	9	.004	2.648	.009
Within Groups	.129	94	.001		
Total	.162	103			

Observing that there are statistically significant differences between the average values of service efficiency indices recorded by men's volleyball teams in the Romanian Division A1 during the 2019-2020 season, we continued our analysis with the nonparametric Kruskal-Wallis test to see whether there were significant differences between teams and we set the following null hypothesis (H_0): the distribution of service efficiency indices was the same for men's volleyball teams in the Romanian Division A1 during the 2019-2020 season.



Total N	104
Test Statistic	22,985
Degrees of Freedom	9
Asymptotic Sig. (2-sided test)	,006

Figure 5. Nonparametric Kruskal-Wallis test results

Figure 5 shows that there are significant differences (H (9) = 22.985, P = .006) in efficiency indices between men's volleyball teams in the Romanian Division A1 during the 2019-2020 season, thus rejecting the null hypothesis (H_0).

We then wanted to see whether there were significant differences between teams, and Figure 6 shows statistically significant differences in service efficiency indices between the CS Știința Explorări Baia Mare and CSM Arcada Galați teams (H (1) = 44.699, P = .013) and the CS Știința Explorări Baia Mare and CS Dinamo Bucharest teams (H (1) = 42.273, P = .046).

For other pairwise comparisons between teams, no statistically significant results were obtained by applying the nonparametric Kruskal-Wallis test.

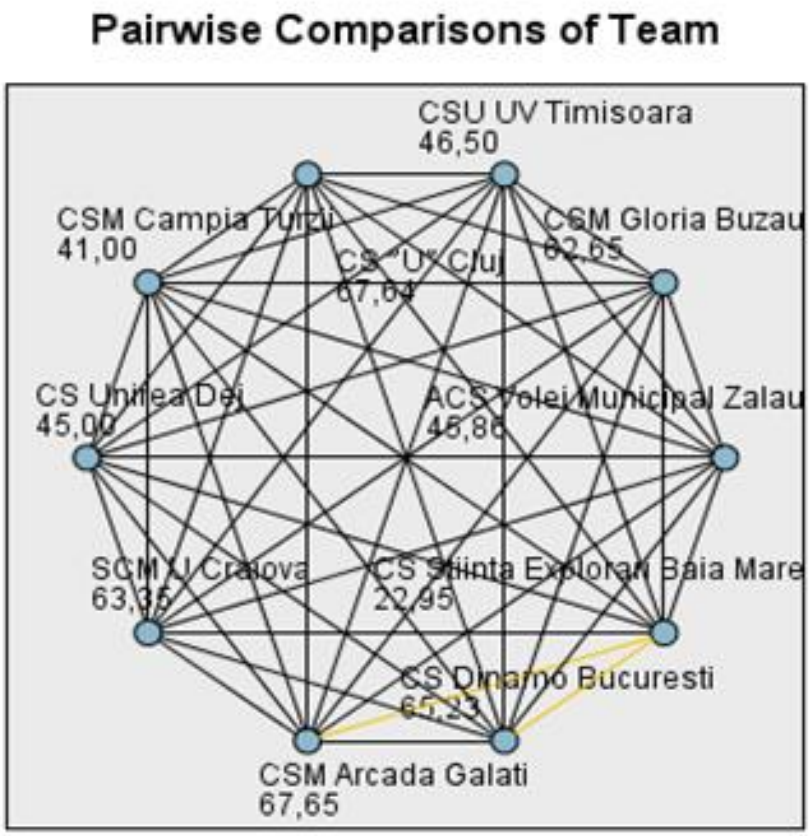


Figure 6. Pairwise comparisons between teams using the nonparametric Kruskal-Wallis test

Therefore, the analysis of the results regarding the relationship between service efficiency indices for men's volleyball teams in the Romanian Division A1 during the 2019-2020 season reveals the existence of significant differences, which is demonstrated by statistical tests confirming that current volleyball service has an important contribution to the game and helps to achieve success.

Conclusion

The results obtained confirm the research hypothesis that "there are statistically significant differences in service efficiency indices between men's volleyball teams participating in the Romanian Division A1 during the 2019-2020 season", as shown by the One-Way ANOVA test in SPSS for the distribution of means (F (9.94) = 2.648, P = .009).

Another conclusion of the study is that the CS Știința Explorări Baia Mare men's volleyball team has the lowest mean of the service efficiency index with a value of .333 and there are no statistically significant differences between this team and the CSM Arcada Galați (H (1) = 44.699, P = .013) and CS Dinamo Bucharest (H (1) = 42.273, P = .046) teams, which is also demonstrated by the nonparametric Kruskal-Wallis test.

The differences in service efficiency indices between men's volleyball teams in the Romanian Division A1 depend on how coaches prepare this action during training and manage to implement the data obtained in official competitions using the Data Volley statistical analysis program.

Following the literature review and the current analysis, we can say that men's volleyball in Romania, in terms of service efficiency indices, does not rise to the level of European and world volleyball, which leads us to think that this game action is not properly trained. Therefore, coaches of the Romanian Division A1 should try a different approach to train this important game action.

References

Beal, D. (1989). Basic team system and tactics. In *Coaches manual I* (Chapter XV, pp. 333-356). FIVB Lausanne.

Borrie, A., Jonsson, G. K., & Magnusson, M. S. (2002). Temporal pattern analysis and its applicability in sport: An explanation and exemplar data. *Journal of Sports Sciences, 20*(10), 845-852. https://doi.org/10.1080/026404102320675675

Castro, J., Souza, A., & Mesquita, I. (2011). Attack efficacy in volleyball: Elite male teams. *Perceptual and Motor Skills, 113*(2), 395-408. https://doi.org/10.2466/05.25.pms.113.5.395-408

Ciemiński, K. (2018). The efficiency of executing technical actions in volleyball and the teams' gender and sports level. *Trends in Sport Science, 3*(25), 159-165. https://doi.org/10.23829/TSS.2018.25.3-6

Deprá, P. P., Brenzikofer, R., Goes, M., & Barros, R. (1998). Fluid mechanics analysis in volleyball serves. *16 International Symposium on Biomechanics in Sports. Germany, Konstanz.* https://ojs.ub.uni-konstanz.de/cpa/article/download/1602/1505/

Häyrinen, M., Lahtinen, P., Mikkola, T., Honkanen, P., Paananen, A., & Blomqvist, M. (2009). Serve efficiency in men's volleyball. *14th Annual Congress of the European College of Sport Science. Book of Abstracts*. Norway, Oslo. http://dx.doi.org/10.13140/2.1.1271.8404

Hilena, R., Arasanz, M., & Garcia-de-Alcaraz, A. (2020). The sequencing of game complexes in women's volleyball. *Frontiers in Psychology, 11*: 739. https://doi.org/10.3389/fpsyg.2020.00739

Inkinen, V., Häyrinen, M., & Linnamo, V. (2013). Technical and tactical analysis of women's volleyball. *Biomedical Human Kinetics, 5*(1), 43-50. https://doi.org/10.2478/bhk-2013-0007

Katsikadelli, A. (1996). A comparative study of the attack serves in high-level volleyball tournaments. *Journal of Human Movement Studies, 30*(6), 259-268.

Laios, A., & Kountouris, P. (2011). Receiving and serving team efficiency in volleyball in relation to team rotation. *International Journal of Performance Analysis in Sport, 11*(3), 553-561. https://doi.org/10.1080/24748668.2011.11868573

Laporta, L., Nikolaidis, P., Thomas, L., & Afonso, J. (2015). The importance of loosely systematized game phases in sports: The case of attack coverage systems in high-level women's volleyball. *Montenegrin Journal of Sports Science and Medicine, 4*(1), 19-24.

MacKenzie, S., Kortegaard, K., LeVangie, M., & Barro, B. (2012). Evaluation of two methods of the jump float serves in volleyball. *Journal of Applied Biomechanics, 28*(5), 579-586. https://doi.org/10.1123/jab.28.5.579

Marcelino, R., Mesquita, I., Sampaio, J., & Moraes, J. (2010). Study of performance indicators in male volleyball according to the set results. *Brazilian Journal of Physical Education and Sport, 24*(1), 69-78. http://doi.org/10.1590/S1807-55092010000100007

Marelič, N., Rešetar, T., Zadražnik, M., & Đurković, T. (2005). Modelling of situation parameters in top level volleyball. In D. Milanović & F. Prot (Eds.), *Proceedings Book of the 4th International Scientific Conference on Kinesiology "Science and profession: A challenge for the future"* (pp. 459-464). University of Zagreb.

Masumura, M., Marquez, W. Q., Koyama, H., & Michiyoshi, A. E. (2007). A biomechanical analysis of serve motion for elite male volleyball players in official games. *Journal of Biomechanics, 40*(Supplement 2): S744. https://doi.org/10.1016/S0021-9290(07)70732-7

Moras, G., Buscà, B., Peña, J., Rodríguez, S., Vallejo, L., Tous-Fajardo, J., & Mujika, I. (2008). A comparative study between serve mode and speed and its effectiveness in a high-level volleyball tournament. *Journal of Sports Medicine and Physical Fitness, 48*(1), 31-36. PMID: 18212707

Palao, J. M. (2018). Side-out success and ways that points are obtained in women's college volleyball. *Journal of Sports Analytics, 4*(4), 243-250. https://doi.org/10.3233/JSA-180153

Palao, J. M., Santos, J. A., & Ureña, A. (2004). Effect of team level on skill performance in volleyball. *International Journal of Performance Analysis in Sport, 4*(2), 50-60. https://doi.org/10.1080/24748668.2004.11868304

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. https://doi.org/10.1515/hukin-2016-0025

Quiroga, M. E., García-Manso, J. M., Rodríguez-Ruiz, D., Sarmiento, S., De Saa, Y., & Moreno, M. P. (2010). Relationship between in-game role and serve characteristics in elite women's volleyball. *The Journal of Strength & Conditioning Research, 24*(9), 2316-2321. https://doi.org/10.1519/JSC.0b013e3181e3812e

Sampaio, J., Ibanez Godoy, S., & Feu, S. (2004). Discriminative power of basketball game-related statistics by level of competition and sex. *Perceptual and Motor Skills, 99*(3 Pt 2), 1231-1238. https://doi.org/10.2466/pms.99.3f.1231-1238

Silva, M., Lacerda, D., & João, P. V. (2014). Game-related volleyball skills that influence victory. *Journal of Human Kinetics, 41*(1), 173-179. https://doi.org/10.2478/hukin-2014-0045

Strohmeyer, H. S. (1996). The jump serves. In K. Asher (Ed.), *The basic elements of the game (Best of coaching volleyball)* (pp. 1-4). Masters Press.

Szabo, D. A., Neagu, N., Teodorescu, S., Pomohaci, M., & Sopa, I. S. (2019). Modalities of exploitation the information provided by the Click & Scout Statistical Program in preparing volleyball attack players. *International Journal of Applied Exercise Physiology, 8*(2.1), 804-811.

Voinea, N.-L., & Rață, G. (2020). Analysis of serve efficiency indices for the Romanian Division A1 women's volleyball teams in the 2019-2020 season. *Sport and Society. Interdisciplinary Journal of Physical Education and Sports, 20*(2). https://doi.org/10.36836/2020/2/14

Zetou, E., Tsigilis, N., Moustakidis, A., & Komniakidou, A. (2006). Playing characteristics of men's Olympic Volleyball teams in complex II. *International Journal of Performance Analysis in Sport, 6*(1), 172-177. https://doi.org/10.1080/24748668.2006.11868365