International Journal of Performance Analysis in Sport
2014, 14, 680-691.

Effects of technique, age and player's role on serve and attack efficacy in high level beach volleyball players

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Abstract

The aim of the present study was to assess effects of technique of execution, age and player's role on serve and attack efficacy. A total of 1.100 serves and 1.165 attacks from under-19, 927 serves and 1.015 attacks from under-21, and 1.564 serves and 1.854 attacks from senior were assessed through video match analysis. Techniques considered for serve were standing serve (SS), jump serve (JS) and float jump serve (FJS); and for attacks were spike and shot. All players were analysed according to their role (defenders or blockers). Results showed that defenders in under-19 and under-21 had better efficacy using SS and FJS, while in senior category the best efficacy was obtained through JS and FJS. Blockers had better efficacy using SS and FJS in all categories. The attack efficacy seems to be independent of player role, although it is related to technique and age. While in senior category attack efficacy was similar using spike and shot, in younger categories it was slightly higher when using spike. This study suggests that serve and attack present different efficacy profiles when considered the technique of execution, player role and age, and therefore it should be considered when planning training programs for teams throughout different phases of athlete development.

Keywords: Match analysis, age group, performance.

1. Introduction

In recent years, research in performance analysis on beach volleyball (BV) has significantly increased (Mesquita *et al.*, 2013). In most instances, these studies have focused on biomechanical (Tilp *et al.*, 2008; Buscà *et al.*, 2012), physical (Medeiros *et al.*, 2014; Palao *et al.*, 2014; Riggs and Sheppard, 2009) and, technical and tactical indicators (Koch and Tilp, 2009; Lopez-Martinez and Palao, 2009; Mesquita and Teixeira, 2004; Yiannis, 2008). These studies have often been used with the purpose of providing thorough information on features, patterns, and specificities of teams' behaviours within competitive contexts, providing valuable data for guiding practice

and research alike.

The technical and tactical indicators have often been analysed from match analysis (Hughes and Franks, 2004). Research has focused, especially, on the impact of rule changes (reduction of court size and the adoption of a rally score system) in these indicators (Giatsis and Papadopoulou, 2003; Giatsis and Tzetzis, 2003; Giatsis, 2003; Giatsis *et al.*, 2003; Ronglan and Grydeland, 2006). Among the game actions studied, serve and attack have been highlighted due to their influence on the final outcome, since these game actions have a greater influence on points obtained by teams (Giatsis and Tzetzis, 2003; Michalopoulou *et al.*, 2005). These studies showed that the outcome of a BV game is affected by the efficacy of the two game actions, serve and attack.

Several studies in BV conducted on these variables (serve and attack) have only been addressed to senior teams playing at the highest levels, showing scarcity of research with younger age groups. Some researchers (Buscà *et al.*, 2012; Jiménez-Olmedo *et al.*, 2012; Koch and Tilp, 2009; Lopez-Martinez and Palao, 2009) found that the jump serve is most used in male games. Furthermore, López-Martinez and Palao (2009) concluded that although the jump serve was the most used and most effective by male players, it was also the one that showed more error in its execution. In relation to the attack, the spike was the most effective technique and the most used by male players (Koch and Tilp, 2009; Mesquita and Teixeira, 2004; Yiannis, 2008). Nevertheless, these studies did not consider the player role (defender and blocker). In team sports, studies from match analysis have been recently considering player role as it can present different performance profiles (Abdelkrim *et al.*, 2010; Laudner *et al.*, 2010; Matthew and Delextrat, 2009; Rocha and Barbanti, 2007; Sheppard *et al.*, 2009). In BV, although these players (defenders and blockers) present distinct functions in defence, all have to serve and attack. Thus, the role performed by the player in defence can influence the efficacy and technique of execution of the serve and attack. Moreover, due to variations in performance characteristics across age groups (Harley *et al.*, 2010), the study of efficacy should consider the technique of execution, age and player role.

To the best of our knowledge, only one study in BV analysed physical performance of players taking into account player role (defenders and blockers) and age. Medeiros et al., (2014) found that the number of jumps performed by defenders and blockers demonstrates different profiles according to age groups. Thus, according to these authors, player role and competitive level of teams influence physical characteristics, and they should be taken into consideration during training by coaches and strength and conditioning coaches.

In this sense, the study of serve and attack efficacy considering the technique of execution, age and player role at the same time, can provide reference values that may help coaches to adjust training programs and objectives to competitions. Moreover, it can offer new insights to design training programs for long-term athlete development. Therefore, this study can give fruitful insights to optimize the preparation process of teams and assist in developing concepts and strategies capable of increasing players' and teams' efficacy. Thus, the aim of the present study was to assess serve and attack efficacy according to the technique of execution and player's role (blocker vs. defender specialist) in under-19, under-21 and senior male BV players.

2. Methods

2.1. Sample and variables

The study sample consisted of 1.100 serves and 1.165 attacks (30 sets of 15 matches) from under-19 (U19), executed by 32 players; 927 serves and 1.015 attacks (24 sets of 12 matches) from under-21 (U21), executed by 30 players; and 1.564 serves and 1.854 attacks (40 sets of 20 matches) from senior (senior), executed by 46 players. Actions were collected from their respective World Championships (season 2010 and 2011). All competitions were organized by FIVB (Fédération Internationale de Volleyball). Only actions from first and second sets of the matches were observed. The studied variables are part of the observation instrument (Manual for observation instrument of techniques and efficacy in beach volleyball - TEBEVOL) designed and validated by Palao and Manzanares (2009). The analyzed variables were the following: serve efficacy (Standing Serve - SS, Jump Serve - JS and Float Jump Serve - FJS) and attack efficacy (spike and shot). Serve and attack efficacy was assessed in a gradual 5-point scale, 0 represents a mistake and 4 represents a point, as described by Palao and Manzanares (2009). With the categories of serve and attack, the performance coefficient was calculated (sum of attempts per category multiplied by the value of the category and divided by total attempts). These variables were studied to describe the efficacy carried out by different age groups, according to player role (defender and blocker). A player was categorized as a defender when he participated less than 20% of the times in a block (Tili and Giatsis, 2011).

2.2. Procedures

The analysed sets were recorded using a digital video camera, which was positioned at the grandstand at a distance of approximately ten meters from the baseline to have a frontal view in order to show the full court.

To guarantee reliability of the observations, intra- and inter-observer agreements were assessed via percentage error method (Hughes *et al.*, 2004; James *et al.*, 2007). After a 3-week period of original observations, to avoid any learning effect, the observer reanalysed 14 random sets (14.9% of total analysed sets). For inter-observer reliability testing, another observer analysed 12 random sets (12.7% of total analysed sets) that had previously been analysed by the original observer. The reliability values obtained were <5% error. Observations were done by an observer who was trained during three sessions of two hours each following the criteria established by Anguera (1991; 2003) and Behar (1993). The observer had a Master's in high performance training with specialization in BV and had been a BV coach in high competition level for ten years.

2.2. Statistical analysis

Data were analysed for practical significance using magnitude-based inferences (Hopkins *et al.*, 2009). This qualitative approach was used due to the fact that traditional statistics do not often indicate the magnitude of an effect, which is typically more relevant to athletic performance than any statistically significant effect (Buchheit and Mendez-Villanueva, 2013). Differences between attack efficacy in relation to technique (spike vs. shot) and serve efficacy (SS vs. FJS, SS vs. JS and, JS vs. FJS) were assessed via standardized mean differences (SMD), computed with pooled variance, and respective 95% Confidence Intervals (95% CI) (Cohen, 1988). Magnitude thresholds for

difference in a mean were described using the following scale: 0-0.2 trivial, >0.2-0.6 small, >0.6-1.2 moderate, >1.2-2.0 large, and >2.0 very large (Hopkins, 2010). If the 95% confidence intervals overlapped small positive and negative values, the magnitude was deemed to be the observed magnitude (Hopkins *et al.*, 2009). Additional meta-analysis was also conducted to assess whether U19, U21, senior, defender and blocker players change from SS to JS, SS to FJS, JS to FJS and spike to shot across the analysed different spatial areas (see figures 1 and 2). Summary measures were calculated using random-effects models that consider both within-analysis and between-analysis variations (Cumming, 2013b). All statistical computations were performed using the software ESCI (Exploratory Software for Confidence Intervals) (Cumming, 2013a).

3. Results

The descriptive analysis (mean ± standard deviation) of serve (SS, JS and FJS) and attack efficacy (spike and shot) according to age group and player role is presented in Table 1. The SMD in serve (SS vs. JS, SS vs. FJS and FS vs. FJS) and attack efficacy (spike vs. shot) in relation to the technique are represented in figures 1 (items a, b and c) and 2, in which the shaded areas indicate thresholds of the observed magnitude effects between game variables.

Table 1. Descriptive analyze of serve and attack efficacy according to player role and age group (mean±stand. deviation).

Variable	Defender						Blocker					
	U19		U21		Senior		U19		U21		Senior	
	%	Efficacy	%	Efficacy	%	Efficacy	%	Efficacy	%	Efficacy	%	Efficacy
Serve												
Standing serve	21.6	1.86±0.80	28.6	1.87±0.78	6.2	1.30±1.08	31.3	1.61±0.61	18.5	1.64±0.77	27.2	1.85±0.77
Jump serve	43.6	1.60±0.67	34.7	1.57±0.61	33.9	1.67±0.66	19.9	1.47±0.88	20.5	1.27±0.82	19.1	1.45±0.93
Float jump serve	34.7	1.77±0.41	36.7	1.76±0.47	59.9	1.90±0.41	48.8	1.74±0.53	60.9	1.82±0.48	53.7	1.84±0.41
Total occurrence	n=573		n=479		n=803		n=527		n=448		n=761	
Attack												
Spike	38.4	2.78±1.33	40.0	2.78±1.40	46.2	2.63±1.21	34.9	2.67±1.38	39.1	2.78±1.35	49.1	2.68±1.36
Shot	61.6	2.52±1.15	60.0	2.48±1.17	53.8	2.65±1.14	65.1	2.58±1.14	60.9	2.46±1.21	50.9	2.55±1.16
Total occurrence	n=544		n=545		n=989		n=621		n=470		n=865	

In relation to analysis of serve, especially in senior category, a small difference was observed between the efficacy of SS and JS (figure 1, item a) for defenders (better efficacy of JS) and blockers (better efficacy of SS). Meta-analysis revealed a small difference between the efficacy of SS and JS (See figure 1, item a) only for blockers. The differences presented indicated that, in this group (blocker), the players have better efficacy using the SS when compared to JS.

For senior category, a moderate difference was observed between the efficacy of SS and FJS for defenders (figure 1, item b). Meta-analysis did not reveal differences between the efficacy of SS and JS (See figure 1, item b) in all the groups.

A moderate difference was observed between the efficacy of JS and FJS for blockers in U21 category and, for defenders and blockers in senior category (See figure 1, item c). Meta-analysis revealed a small difference between the efficacy of JS and FJS (figure 1, item c) for U21, senior and blocker. The differences presented indicated that, in these three groups (U21, senior and blocker), players have better efficacy using FJS when compared to JS.

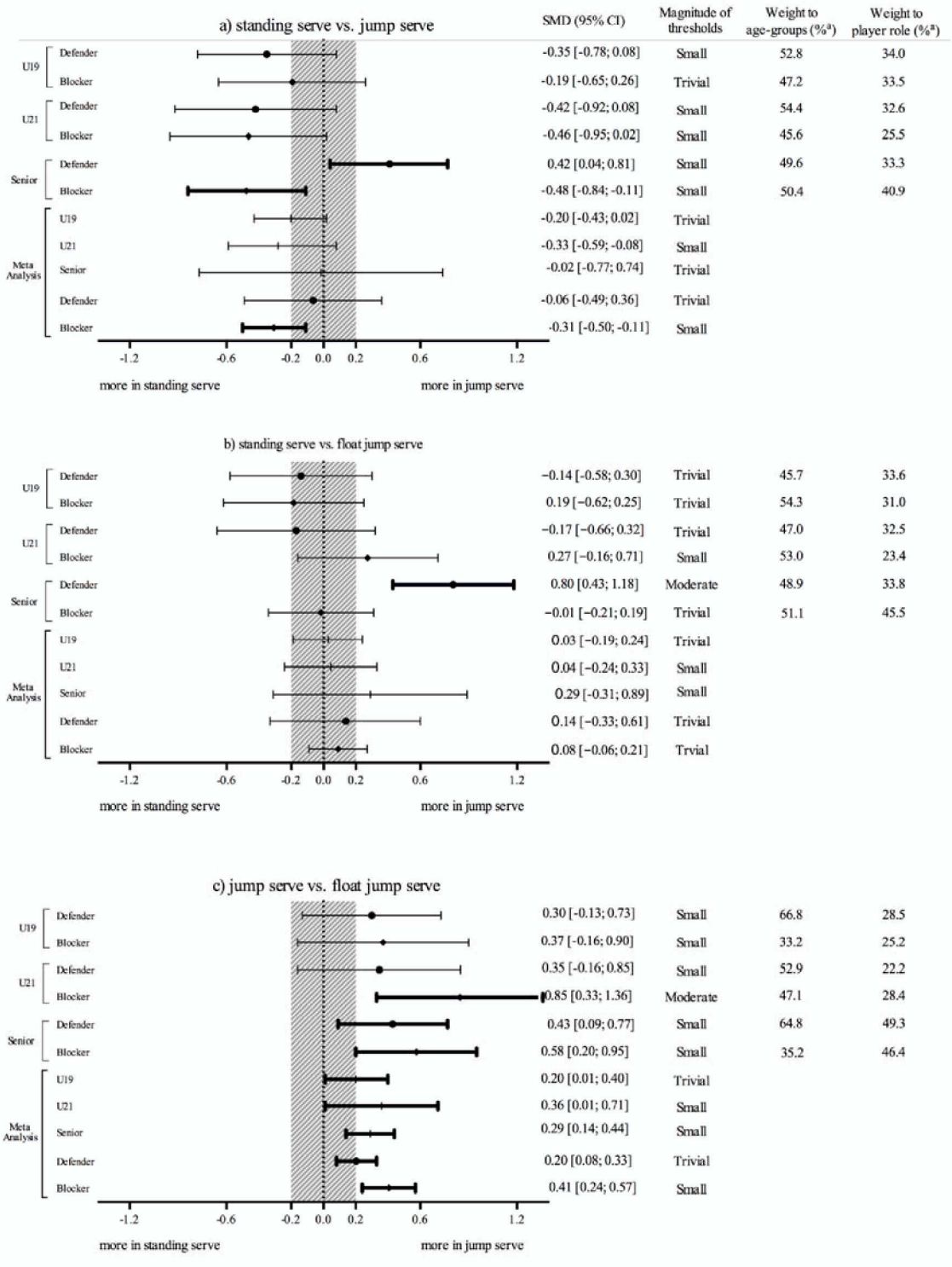

Figure 1. Standardized mean difference and meta-analysis assessing the serve efficacy in relation to the technique (SS vs. JS, SS vs. FJS, and JS vs. FJS) and player role (defender and blocker).
[a] Weights are from random-effects analysis.
Abbreviation: SMD = standardized mean difference.
The shaded area represents the smallest (trivial differences) worthwhile change (see "Methods").

Results showed that attack efficacy were not different according to technique (spike vs. shot) (figure 2), although defenders and blockers from younger categories (U19 and U21) showed a slightly higher efficacy with the spike. There was only an exception revealed in the meta-analysis showing a small difference between the efficacy of spike and shot (figure 2) for U21. The difference presented indicated that in this group players have better efficacy using spike when compared to shot.

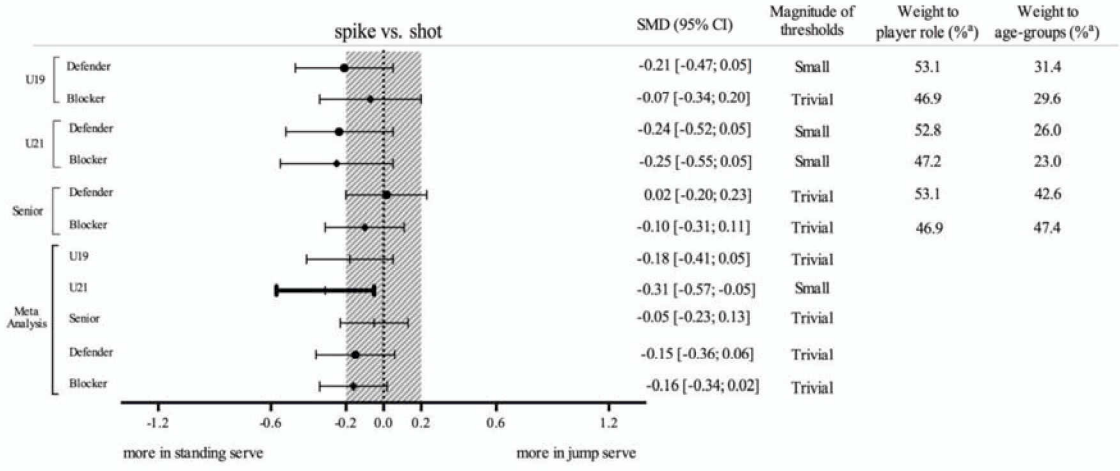

Figure 2. Standardized mean difference and meta-analysis assessing the attack efficacy in relation to the technique (spike vs. shot) and player role (defender and blocker).
[a] Weights are from random-effects analysis.
Abbreviation: SMD = standardized mean difference.
The shaded area represents the smallest (trivial differences) worthwhile change (see "Methods").

4. Discussion

The study aimed to assess the serve and attack efficacy according to the technique of execution and player's role (blocker vs. defender specialist) in U19, U21 and senior male BV players. Overall, findings showed that serve efficacy varies according to the techniques used, player role and players' age. On the other hand, the attack efficacy seems to be independent of the player role, although it is related to the technique of execution and players' age.

Relatively to the serve, the FJS was the most used by defenders and blockers in all categories, with the exception of defenders in U19 category, where JS presented the highest frequency. These findings show that players used more serves that create greater difficulties in opponent's reception through ball fluctuation (i.e. FJS) (Takeshi *et al.*, 2010) or directions of the ball to specific zones of the court. Differences were found in efficacy according to the technique of execution between defenders and blockers in different categories. The blockers from all categories had better efficacy using SS and FJS. This could be due to their higher height (Palao *et al.*, 2008) that allows them a better angle incidence in the opponent court with ball fluctuation and not requiring an additional physical load that could affect their next actions (i.e. block).

For defenders, regardless of the category, players had better efficacy using FJS. However, while in younger categories there were also better efficacies using SS, seniors

had better efficacies using JS. Since younger players do not evaluate properly the risk of their actions, until they accumulate experience, they use the serves (i.e., SS and FJS) that allow more balance between point and error and, consequently, more chance to achieve success.

Previous studies showed that the JS was the most used and most effective serve in men's BV (Buscà *et al.*, 2012; Jiménez-Olmedo *et al.*, 2012; Koch and Tilp, 2009; Lopez-Martinez and Palao, 2009). These differences may be related to the fact that these studies did not consider the player role, which can influence the results due to the technical and tactical strategies adopted by the players that are dependent on their role and physical demands. Although there is no empirical evidence, the change in the type of ball in 2009 may have also affected its fluctuation and thereby the efficacy of the different techniques. Future studies in BV should consider the analysis of the ball fluctuation in different types of serve as well as its influence with efficacy, considering the player role.

Regarding the attack, defenders and blockers in U19 and U21 categories had a slightly better efficacy using the spike; whereas in senior category, there was equilibrium of the players' efficacy between spike and shot. This may be because the more experienced players (senior) are strategically more evolved and make use of all the resources to gain advantage over opponents. Despite some studies in senior competitions having shown that the spike was the most effective technique (Koch and Tilp, 2009; Mesquita and Teixeira, 2004; Yiannis, 2008) they favoured the use of percentages as a measure of evaluation, which might not be suitable to identify the relationship between points earned, points lost or total attempts. As a result, to obtain this information it is necessary to refer to values of performance coefficients (Coleman *et al.*, 1969) that consider all executions done in this calculation, thus providing more qualitative information in sports performance (Marcelino *et al.*, 2010), as the one used in this study. Further research should emphasize the use of performance coefficient in order to provide more reliable and helpful information about players and teams performance.

Results showed different patterns on the technique used to perform the attack throughout different age groups, from an imbalance use of shot and spike in younger categories to a balanced use in seniors. The greater use of shot in U19 and U21 may be related to the players' ability to control the ball or their fatigue. Moreover, the balance between the use of spike and shot in the senior category could be due to the fact that these players are more tactically evolved and, therefore use more resources to gain advantage over opponents. Our results do not corroborate with previous studies (Koch and Tilp, 2009; Mesquita and Teixeira, 2004; Yiannis, 2008), which showed a higher use of spike by senior players. These differences can be the result of the game evolution in need for more tactical demands in order to manage the risk through technical variability, requiring further research to confirm this tendency.

In brief, serve efficacy showed to be more dependent on player role than attack efficacy. Indeed, serve efficacy undergoes changes according to the technique of execution, player role and age of players. On the other hand, attack efficacy seems to be independent of the player role, although it is related to the technique of execution and category. These findings allow a deeper understanding on game performance,

particularly about the need to consider the specificity of game action to plan and design training programs. Thus, serve and attack should be trained taking into account the players' role throughout their development, in order to perform the technique that can lead them to achieve a better performance in the game. Moreover, further studies are needed to contextualize the conditions where the players' executions are performed (e.g. wind, momentum or quality of opposition), as in BV these factors can affect game performance.

5. Acknowledgements

This research was supported by CAPES (Brazilian Ministry of Education), Doctoral grants program (BEX 0688/12-6/2012-2015).

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