



Influence of Contextual Variables on Performance of the Libero Player in Top-Level Women's Volleyball

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Sports performance changes dynamically according to multiple variables during a match. Contextual variables play an important role in complex situations and influence player's performance depending on the player's role. The aim of this study was to analyze performance of the libero player in terms of contextual variables in top-level women's volleyball. The sample comprised 1,597 actions performed by libero players in 49 sets (13 matches) played in the Spanish Queen's Cups from 2015 to 2017. The variables analyzed were: the game phase, the match period, the set period, match status, the type of the match, and action performance. The results revealed higher participation in the reception and digging, and top performance in reception and setting. The participation of the libero player decreased at the end of the match and the set as well as in advantage score situations, while performance got worse at the end of the set (especially in digs, $p < .05$) and improved in score advantage situations (especially in receptions, $p < .05$). Performance remained stable regardless of the type of the match ($p > .05$). These results may be useful to coaches in order to plan and design specific tasks coherent with libero competition demands and performance values.

Key words: team sports, performance analysis, game phase, player's role.

Introduction

Sports performance analysis provides objective information based on a series of performance indicators (O'Donoghue, 2010). Given the dynamic nature of the sport, a detailed analysis of these indicators is needed because of the influence external conditions, known as situational variables such as the quality of opposition, the game period, match status, etc. (Gómez et al., 2013), or internal features such as the play role, the game phase, etc., may have on such indicators. As to the dynamics of volleyball, various game phases may be identified in terms of actions performed in a hierarchical and cyclical way (Eom and Schutz, 1992a). Performance of these actions varies in terms of the player's role (Marques et al., 2009; Sheppard et al., 2009), and this type of information is crucial for planning and training athletes according to real game demands.

When it comes to the dynamics of volleyball, six game phases or complexes may be observed (Hileno and Buscà, 2012): (a) K0 – where there is an isolated serve action, and the libero does not intervene; (b) KI – made up of the reception of the serve, a set and an attack; (c) KII – when there is a response to KI attack; it consists of a block or a dig, a set and a counter-attack; (d) KIII – which is similar to KII, yet occurs as a response to counter-attack actions; (e) KIV – which derives from a dig action which aims at neutralizing the ball that bounces back from the opponent's block; and (f) KV – that derives from a dig of a "free-ball" (opponent passes the ball without spiking the ball over the net).

From 1998, the International Volleyball Federation (FIVB) introduced the libero role which would play at back positions and perform receptions, digs or sets, but would not perform serves or blocks, or complete an attack hit with

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the ball over the top of the net (International Volleyball Federation, [FIVB], 2016). According to the rules, libero players usually participate at the starting phase of each game complex (except K0) by keeping the ball in action (a reception or a dig) or preparing the attack action for a partner (a set). The libero player is the only player role whose actions are determined by fixed game rules, which constrain the superiority of an attack against defence situations and facilitate game continuity, thus resulting in greater entertainment. Therefore, the libero participates in actions that allow the continuity of the game (Eom and Schutz, 1992a). Continuity actions are extremely important in the game and their performance improves along the match (Marcelino et al., 2009). Reception and dig performance influences attack efficacy and is related to the match outcome (Valladares et al., 2016), while set performance influences the type and efficacy of the attack (Bergeles et al., 2009). In particular, when the libero plays in KI, reception performance improves and attack efficacy increases (João et al., 2006). Also, when the libero performs in defence phases (KII or KIII), dig efficacy increases without influencing counter-attack performance (Mesquita et al., 2007).

Despite the clear impact of the libero player on the game, few research studies have been found on libero's performance in terms of contextual (e.g., match status) or game phases variables. Furthermore, most of those studies analyze male competitions (João et al., 2006; Mesquita et al., 2007). Therefore, the research question is whether contextual variables influence female libero's performance. This gap of information should be covered in order to expand the knowledge about the actual involvement of the libero in play and provide coaches with hands-on information, especially in women's volleyball. Knowledge about contextual influence on a specific player's role performance should guide new research into the coordination amongst players that cooperate dynamically against their opponents. Thus, the aim of this study was to analyze performance of the libero players in terms of contextual variables in top-level women's volleyball.

Methods

Participants

The sample comprised 1,597 actions

performed by libero players in 49 sets (13 matches) played in the Spanish Queen's Cups in 2015 (3 matches), 2016 (5 matches) and 2017 (5 matches). This tournament was played by the best six teams classified at the end of the first round of the regular league. The actions observed were classified in terms of the game phase and the type of action. The recording procedure did not distort players' natural behaviour as recording matches is a common practice (Palao and Hernández, 2014). Tournament organizers authorized filming of the matches.

Design and Procedures

An observational design was implemented (Anguera, 2003) and the variables analyzed were as follows:

- (a) *game phase*: KI (a side-out or an attack phase), KII (a serving phase: a dig from an attack), KIII (a counter-attack phase: a dig from a counter-attack), KIV (a dig from an offensive block), and KV (a free-ball phase) (Hileno and Buscà, 2012);
- (b) *action performed*: a reception, a set, a dig from a spike (an attack or a counter-attack), a dig from an offensive block, a free-ball or an attack hit;
- (c) *match period*: set game from the first to the fifth set according to game rules (FIVB, 2016);
- (d) *set period*: an initial phase (from 0 to 9 points in the first to the fourth set, and from 0 to 4 points in the fifth set), a medium phase (from 10 to 19 points in the first to the fourth set, and from 5 to 9 points in the fifth set), and a final phase (from 20 points to the end of a set in the first to the fourth set, and from 10 points to the end of the fifth set);
- (e) *match status*: disadvantage, equality or advantage in score;
- (f) *type of a match*: a quarter final, a semifinal and a final; and
- (g) *performance*: game influence of ball contact coming from the libero player (Table 1) (adapted from García-de-Alcaraz et al., 2014, 2016; Mesquita et al., 2007).

Matches were recorded with a video camera located at height above the net at the back of the court, thus allowing the full view of games. The actions observed were entered in an Excel file. The observer was a Sport Sciences postgraduate with academic training in volleyball and experience as a volleyball player in national competitions. Reliability of recordings was measured by an expert volleyball observer with a PhD in Sport Sciences who taught volleyball in

higher education. Intra- and inter-reliability tests were performed with 20% of the sample which was randomly selected. The Cohen's Kappa test showed strong agreement ($\kappa = .78$ intra-; and $\kappa = .73$ inter-reliability).

Statistical Analysis

Data were analyzed in a descriptive and inferential way using Kolmogorov-Smirnov (normality distribution) and *U*-Mann Whitney tests. The level of significance was set at $p < .05$. Data were analyzed with SPSS v.21. (Statistical Package for the Social Sciences, SPSS Inc).

Results

Table 2 shows the performance of each action in terms of the game phase. On the one hand, receptions and digs were the actions performed most frequently by the libero player in any game phase as well as the free-ball. The libero performed several setting actions in different game phases with higher frequency in defence phases such as KII and KIII. Finally, the libero also performed various attack hits in order to

send the ball to the opponent court. On the other hand, best performances occurred in the reception in KI and in the setting action in the rest of game phases.

In terms of the match period (set game) (Table 3), the libero player participated most frequently in the reception in KI, while there was a decrease in the number of executions and an increase in performance as the match progressed. In KII and KIII, the prevailing action was the dig with best performances in the 2nd, the 4th, and the 5th set. In KIV and KV, the dig from the opponent block and free-ball, respectively, were the prevailing actions with a decrease in participation in the former, and a decrease in performance in the latter along the sets. The setting action was the most frequently used in KII and KIII, yet especially in KIII. Few attack hits (3rd contact) were performed in order to send the ball to the opponent's court. These actions only appeared in KI, KII and KIII. No statistically significant differences were found in actions performed between sets.

Table 1

Performance of actions played by the libero player

Performance	Definition	Actions
Error (0)	The libero performs a fault when touching the ball, or the play does not continue after the libero's contact.	Reception, dig, dig from an offensive block, set, free-ball and attack hit
Poor quality (1)	The libero's contact with the ball allows continuity, but the team cannot build an offensive action	Reception, dig, dig from an offensive block and free-ball
	The setting ball cannot be attacked	Set
	The attack is easily dug by the opponent, who counter-attacks with all options	Attack hit
Acceptable quality (2)	The libero's contact allows continuity, but the team builds an offensive action with some limitations	Reception, dig, dig from an offensive block
	The setting ball can be attacked with some limitations	Set
	The attack is dug by the opponent, who counter-attacks with limited options	Attack hit Note: free-ball is not recorded here
Good quality (3)	The libero's contact allows continuity and the team builds an offensive action with all options	Reception, dig, dig from an offensive block and free-ball
	The setting ball can be attacked without limitations	Set
	The opponent team cannot dig the ball coming from the libero player.	Attack hit

Table 2*Performance in various actions in terms of the game phase*

Game phase	Action	Performance	
		<i>n</i>	Mean ± Sd
KI (side-out) (<i>n</i> = 667)	Reception	631	2.58 ± .83
	Set	29	2.48 ± .87
	Attack hit	7	1.00 ± .00
KII (serve phase) (<i>n</i> = 279)	Dig	207	1.91 ± 1.24
	Set	65	2.65 ± .69
	Attack hit	7	0.86 ± .38
KIII (counter-attack phase) (<i>n</i> = 392)	Dig	270	1.99 ± 1.25
	Set	111	2.56 ± .79
	Attack hit	11	0.91 ± .30
KIV (dig from opponent block) (<i>n</i> = 121)	Dig	87	1.93 ± 1.19
	Set	34	2.38 ± .95
KV (free-ball) (<i>n</i> = 138)	Free-ball	131	1.95 ± .23
	Set	7	2.71 ± .49

Table 3*Performance of the libero player in terms of the game phase, actions and the match period*

	Action	Set 1		Set 2		Set 3		Set 4		Set 5	
		<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd
KI (<i>n</i> = 667)	Reception	181	2.56 ± .84	174	2.56 ± .84	169	2.60 ± .85	85	2.58 ± .78	22	2.77 ± .69
	Set	10	2.70 ± .67	7	1.86 ± 1.21	8	2.50 ± .76	3	3.00 ± .00	1	3.00
	Attack hit	1	1.00	4	1.00 ± .00	1	1.00	1	1.00	0	
KII (<i>n</i> = 279)	Dig	63	1.75 ± 1.32	44	2.09 ± 1.14	53	1.83 ± 1.28	41	2.05 ± 1.18	6	2.00 ± 1.26
	Set	12	2.75 ± .62	24	2.67 ± .64	18	2.56 ± .86	9	2.78 ± .44	2	2.00 ± 1.41
	Attack hit	2	1.00 ± .00	0		2	1.00 ± .00	2	1.00 ± .00	1	0
KIII (<i>n</i> = 392)	Dig	61	1.93 ± 1.28	62	2.06 ± 1.25	80	1.85 ± 1.29	52	2.13 ± 1.16	15	2.13 ± 1.25
	Set	27	2.52 ± .89	36	2.58 ± .81	32	2.53 ± .76	15	2.60 ± .74	1	3.00
	Attack hit	1	1.00	4	0.75 ± .50	3	1.00 ± .00	3	1.00 ± .00	0	
KIV (<i>n</i> = 121)	Dig	22	1.95 ± 1.21	21	1.90 ± 1.09	19	2.05 ± 1.03	16	1.56 ± 1.41	9	2.33 ± 1.32
	Set	7	2.43 ± .98	10	2.60 ± .70	7	2.43 ± .79	8	2.13 ± 1.36	2	2.00 ± 1.41
KV (<i>n</i> = 138)	Free-ball	28	2.00 ± .00	42	1.98 ± .15	34	1.91 ± .29	20	1.95 ± .22	7	1.71 ± .49
	Set	5	2.80 ± .45	1	2.00	0		0		1	3.00

Table 4*Performance of the libero player in terms of the game phase, actions and the set period*

		Initial phase		Medium phase		Final phase	
		<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd
KI (<i>n</i> = 667)	Reception	243	2.58 ± .76	240	2.56 ± .91	148	2.61 ± .80
	Set	12	2.67 ± .65	10	2.10 ± 1.10	7	2.71 ± .76
	Attack hit	2	1.00 ± .00	4	1.00 ± .00	1	1.00
KII (<i>n</i> = 279)	Dig	82	2.01 ± 1.19	80	1.88 ± 1.28	45	1.78 ± 1.28
	Set	24	2.83 ± .56 ^c	19	2.63 ± .68	22	2.45 ± .80 ^a
	Attack hit	2	1.00 ± .00	1	1.00	4	0.75 ± .50
KIII (<i>n</i> = 392)	Dig	109	2.06 ± 1.24	103	2.03 ± 1.19	58	1.78 ± 1.35
	Set	52	2.52 ± .83	41	2.54 ± .84	18	2.72 ± .57
	Attack hit	4	0.75 ± .50	6	1.00 ± .00	1	1.00
KIV (<i>n</i> = 121)	Dig	25	2.00 ± 1.15	43	2.12 ± 1.12 ^c	19	1.42 ± 1.30 ^b
	Set	10	2.50 ± .97	14	2.43 ± 1.02	10	2.20 ± .92
KV (<i>n</i> = 138)	Free-ball	49	1.96 ± .20	53	1.94 ± .23	29	1.93 ± .26
	Set	1	3.00	4	2.50 ± .58	2	3.00 ± .00

Note. a: $p < .05$ according to the set initial phase; b: $p < .05$ according to the medium phase; c: $p < .05$ according to the final phase.

Table 5*Performance of the libero player in terms of the game phase, actions and match status*

		Disadvantage		Equality		Advantage	
		<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd
KI (<i>n</i> = 667)	Reception	353	2.55 ± .85 ^c	77	2.55 ± .84	201	2.66 ± .79 ^a
	Set	15	2.33 ± 1.05	4	2.50 ± .58	10	2.70 ± .67
	Attack hit	5	1.00 ± .00	0		2	1.00 ± .00
KII (<i>n</i> = 279)	Dig	78	1.74 ± 1.28	19	2.05 ± 1.22	110	2.00 ± 1.21
	Set	16	2.38 ± .96	6	2.67 ± .82	43	2.74 ± .54
	Attack hit	3	1.00 ± .00	0		4	0.75 ± .50
KIII (<i>n</i> = 392)	Dig	122	1.89 ± 1.25	44	2.07 ± 1.26	104	2.07 ± 1.25
	Set	48	2.65 ± .73	17	2.47 ± .87	46	2.50 ± .84
	Attack hit	5	0.80 ± .45	1	1.00	5	1.00 ± .00
KIV (<i>n</i> = 121)	Dig	40	2.03 ± 1.10	14	1.86 ± 1.23	33	1.85 ± 1.30
	Set	15	2.27 ± 1.03	7	2.14 ± 1.21	12	2.67 ± .65
KV (<i>n</i> = 138)	Free-ball	63	1.92 ± .27	15	2.00 ± .00	53	1.96 ± .19
	Set	3	2.67 ± .58	0		4	2.75 ± .50

Note. a: $p < .05$ according to disadvantage; b: $p < .05$ according to equality; c: $p < .05$ according to advantage.

Table 6*Performance of the libero player in terms of the game phase, actions and the type of the match*

		Quarter final		Semifinal		Final	
		<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd	<i>n</i>	Mean ± Sd
KI (<i>n</i> = 667)	Reception	207	2.61 ± .79	273	2.52 ± .87	151	2.65 ± .79
	Set	9	2.44 ± 1.01	14	2.43 ± .85	6	2.67 ± .82
	Attack hit	2	1.00 ± .00	4	1.00 ± .00	1	1.00
KII (<i>n</i> = 279)	Dig	67	2.01 ± 1.17	88	1.84 ± 1.27	52	1.88 ± 1.29
	Set	21	2.67 ± .73	32	2.63 ± .66	12	2.67 ± .78
	Attack hit	2	1.00 ± .00	3	1.00 ± .00	2	0.50 ± .71
KIII (<i>n</i> = 392)	Dig	88	2.10 ± 1.23	128	1.98 ± 1.25	54	1.83 ± 1.28
	Set	44	2.41 ± .97	38	2.74 ± .50	29	2.55 ± .78
	Attack hit	4	1.00 ± .00	4	1.00 ± .00	3	0.67 ± .58
KIV (<i>n</i> = 121)	Dig	19	1.63 ± 1.26	42	1.88 ± 1.21	26	2.23 ± 1.07
	Set	11	2.36 ± .92	13	2.23 ± 1.01	10	2.60 ± .97
KV (<i>n</i> = 138)	Free-ball	45	1.91 ± .29	57	1.95 ± .23	29	2.00 ± .00
	Set	4	2.75 ± .50	2	2.50 ± .71	1	3.00

Regarding the set period (Table 4), there was a general decrease in the number of actions performed by the libero player as the game progressed to the end of the set. Also, performance of actions decreased, except for the reception (in KI) and the setting action in KI and KIII. A statistically significant decrease was found in setting action between the initial and the final set phase in KII ($z = -2,359$; $p = .018$), and in digs from the opponent's block between the medium and the final set phase in KIV ($z = -2,010$; $p = .044$).

In terms of match status (Table 5), the libero player participated more frequently in advantage or disadvantage situation, and performed better with a score advantage (receptions, digs in KIII, and setting actions in all game phases except in KIII). In a score disadvantage situation, only digs from the opponent's block (in KIV) and setting actions in KIII showed best performance, whereas digs in

KII and free-balls presented best performance at score equality. Only receptions showed a statistically significant improvement in performance in advantage scores situations ($z = -2,125$; $p = .034$).

As to the type of the match (Table 6), final matches exhibited best performance in almost all actions, except for the setting action in KIII (a semifinal match) and the dig in KII and KIII (a quarter-final match). No statistically significant differences in performance of actions were found between various types of matches.

Discussion

The aim of this research study was to analyze performance of the libero player in terms of contextual variables in top-level women's volleyball. The results revealed that top-level female libero players performed the majority of actions in the reception and digging, and showed

best performance in receptions and setting. Participation of the libero player decreased at the end of the match and the set, as well as in advantage score situations. Also, performance tended to get worse at the end of a set and improved in score advantage situations. Nevertheless, performance remained stable regardless of the type of a match.

The first actions in each game phase were most frequently performed by the libero player in any game phase. This fact is the main reason why this role was introduced in volleyball, namely, to allow progression of the game by keeping the ball in action. The best performances were found in the reception (KI) compared to digs (KII or KIII) or digs from the opponent's block (KIV). Performance superiority of the reception is related to low contextual interferences in KI phase because the ball comes from the opponent's serve, which is an action played far from the net and performed by a single player. In contrast, higher contextual interferences lead to worse performance in digs because the ball comes from attacks or counter-attacks, that is, actions played close to the net, in which the setter can also perform various offensive combinations (Castro et al., 2011). Thus, best performance in a reception (compared to a dig) and its relationship with attack efficacy (Eom and Shutz, 1992b; João et al., 2006) lead to less game continuity, which does not support the reason why the libero player was introduced in the first place.

Following contextual interferences proposed by Castro et al. (2011), a special interest arises in performance superiority of digs in KIII when compared to digs in KII. Better performance of digs in KIII may be associated with lower contextual interferences of this complex because digs occur from an opponent's counter-attack, and therefore, in a more "predictable" situation than digs in KII, which derive from an opponent's attack, and thus with higher contextual interferences.

Regarding the match period, although no statistically significant differences were found in performance, only receptions in KI and digs and setting in KIII exhibited moderate improvements as a match progressed. This result coincides partially with a study of Marcelino et al. (2009), who found an increase and stabilization of performance in continuity actions (receptions, sets

and digs) along a match. The lack of improvement in the rest of actions (digs or sets in KII, KIV, etc.), and a general trend of the libero player to participate to a lesser extent might be associated with the specific location of the libero player on the court (Mesquita et al., 2007), teams' ability and strategies (João et al., 2006), or offensive decisions of the opponents' team.

As to the set period, a decrease in the number of actions performed by the libero player at the end of a set may be associated with opponents' strategies aimed at identifying players who may be less capable or more involved in other actions (e.g., a front-line player who receives and attacks). Moreover, this decrease could be associated with the fact that not all teams complete the final part of a set. Nevertheless, the general decrease in performance of libero players (except the reception in KI and the set in KI and KIII) may be related to fluctuations and decreases in performance at crucial moments of a match, a phenomenon known as "choking under pressure" (Hill et al., 2010). The statistically significant decrease in setting actions in KII and digs from the opponent's block in KIV could also be related to higher contextual interferences of these complexes, or changes in coverage systems performed in different game phases (in KIV). Structure and performance of coverage systems vary according to the game phase (Hileno et al., 2018).

In terms of match status, although only a statistically significant increase was found in the reception in score advantage situations, a general improvement could be observed in these situations. This fact could be associated with favourable conditions and players' confidence in such situations. Match status and quality of opposition are only associated with tactical behaviours in top-level men's volleyball (Marcelino et al., 2011). In the present study, the specific analysis of match status points at an influence of this situational variable on technical performances in top-level women's libero players. However, further research on this topic is needed.

Regarding the type of the match, although no statistically significant differences were found between various types of matches, final matches exhibited best performances in almost all actions, which resulted in better performance when best teams and players confronted. This result may be

associated with interactive effects of other situational variables such as the quality of opposition, the match period or match status (Lago, 2009). This combination of variables should be explored in future studies.

This study is a first attempt to present current data on the competition demands of the libero player in women's volleyball in terms of contextual variables. However, some limitations of this study should be addressed. First, performance of the libero player was not compared to other player's roles, although some studies addressed the issue of better performance of libero players in the reception (Callejón and Hernández, 2009; João et al., 2006) and in the dig (Mesquita et al., 2007) in top-level men's volleyball. Nevertheless, the results of this study reveal the importance of training the libero player in situations other than the first actions in a complex (receptions or digs). Thus, training of the set is crucial to facilitate offensive actions. In this respect, Eom and Shutz (1992b) emphasized that the relationship between the set and the counter-attack is stronger than the relationship between the dig and the counter-attack. Moreover, the libero player can attack (with rule limitations) and, although this may occur a few times in a match, players should make the most of it in order to gain an advantage.

Conclusions

Participation and performance of top-level libero players in women's volleyball vary in terms of the game phase. The greatest participation occurs in receptions and digs, and best performances occur in sets and receptions.

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The participation of the libero player decreases at the end of the match and the set, as well as in advantage score situations. Also, performance decreases at the end of the set, and improves in score advantage situations. The type of the match does not influence performance.

Future research studies should compare different player's roles, and also analyze the reception or dig technique (forearm or overhand execution), the area in which the libero player plays, interactions between players, or the ball trajectory and speed of the ball coming from the opponent's court, etc. In particular, variations in performance of libero players may be a relevant research topic possibly related to the flow or rhythm of performance of this role. In addition, further research should focus on initial stages.

Practical implications

The results of this study may be useful to coaches and players. Specific training plans and physical conditioning programs may be designed thanks to research data on performance of the libero player. An emphasis in game phases is an important feature that may lead to specific training situations, particularly in defensive complexes such as KII and KIII. Also, the analysis of all actions that the libero player may perform sheds light on training in situations other than typical training of the reception and the dig in similar conditions. Moreover, these data can be used as reference values in order to promote talent development so that players may reach top-level scenarios in women's volleyball.

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