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EVOLUTION OF ATTACK EFFICACY AND EXECUTION IN WOMEN'S VOLLEYBALL ACCORDING TO AGE GROUP AND LEVEL OF COMPETITION

Carlos Echeverria [1], Enrique Ortega [1], and José M. Palao [2,*]

[1] University of Murcia, Department of Physical Activity and Sports, Murcia, Spain

[2] University of Wisconsin, Parkside, Department of Health, Exercise Science and Sport Management, Kenosha, WI, United States

Corresponding author: palaojm@gmail.com

ABSTRACT

The aim was to determine the evolution of the attack regarding the way of execution and efficacy level according to the age group and level of competition in female volleyball. The sample was composed of 48 matches in U14, U16, U18, senior 2nd national division, senior 1st national division, and senior international level. The studied variables were the age group and level of competition, game phase, attack technique, attack zone, attack destination, attack tempo, and attack efficacy. At higher levels of competition: a) the number of quick spikes increases, b) the efficacy of the high-ball spike in the side-out phase increases, c) there is a higher number of attacks from back-row players, and d) the efficacy of front-row spikes in the side-out phase increases.

Keywords: team sport, sports performance, match analysis, developmental stage

INTRODUCTION

In volleyball, the attack is the action that generates more points and correlates more with the final score in a set and in a game (Castro, Cavalli, Alves & Grecco, 2014; Castro, Souza & Mesquita, 2011; Drikos & Vagenas, 2011; Marcelino & Mesquita, 2006; Marcelino, Mesquita, Castro & Sampaio, 2008; Palao, Santos & Ureña, 2004; Rodríguez-Ruiz et al., 2011; Stamm, Stamm & Koskel, 2008). The aim of the offensive actions, spiking included, is to win the point or reduce the options of being blocked and hamper the defensive structure of the opposite team (Bergeles & Nikolaidou, 2011; Castro & Mesquita, 2010; Castro et al., 2011; Inkinen, Häyrinen & Linnamo, 2013). Performance in spiking is related to the height of hitting, the speed of hitting, and the direction of the ball's trajectory (Castro et al., 2011; Costa, Afonso, Barbosa, Coutinho & Mesquita, 2014; Costa,

Mesquita, Greco, Ferreira & Moraes, 2010a, 2010b; Duncan, Woodfield & al-Nakeed, 2006; Lidor & Ziv, 2010; Malousauris et al., 2008; Stamm et al., 2006; Valadés, Palao & Bermejo, 2013). These aspects change through players' development, due to physical maturation, training and experience gained (Grgantov, Katic & Jankovic, 2006; Lidor & Ziv, 2010a; Stamm et al., 2003; Stamm et al., 2004). These changes made their spikes theoretically more efficient. However, the opposite team also improves its skills in block and defense actions, so that the evolution of these aspects and their relationship affects the offensive dynamics of the game.

The cyclic sequence of game actions makes the attack an action under the influence of the previous actions, like serve (Costa, Afonso, Brant & Mesquita, 2012; Costa, Mesquita, Greco, Ferreira & Moraes, 2011b), reception/defense (Durkovic, Marelic & Resetar, 2008; Eom & Schultz, 1992b) and setting (Bergeles, Barzouka & Nikolaidou, 2009; Eom & Schultz, 1992b; Palao et al., 2005). As the players' age increases, those relations may change in the way of getting faster attack actions and more complex and diverse attacking options (Bergeles & Nikolaidou, 2011; Castro et al., 2011; Katsikadelli, 1995; Marcelino, Afonso, Moraes & Mesquita, 2014; Palao et al., 2005). Attack in female volleyball are lower and less powerful than in male volleyball (Costa et al., 2012), but they are still highly effective due to the lower height of the block, reaction capacity and speed of defensive line in the opposite's team (Bergeles et al., 2009). There is also found in female volleyball a different way of building the offense than in male volleyball, with reduced participation of backcourt attackers (Castro et al., 2014) and the use of one-leg-take off attacking (Palao et al., 2005).

The information found about the analysis of how setter organizes the offense shows a trend to accelerate the offense as higher is the age group (Palao & Echeverría, 2008). However, it is not clear how the attack offense evolves, from the lower levels to the higher, due to the evolution also of other actions of the game. The information about the way of execution and their efficiency in the different competition levels should enhance knowledge of how the training process takes effect. These also provide guidelines for training to coaches about the long-term development process of the athletes in women volleyball. The aim of the study was to determine the technical performance profile of the attack regarding the way of execution and efficacy level according to the age group and level of competition in female volleyball.

METHOD

The sample was 11,470 sequences played in 187 sets, corresponding to 48 volleyball matches. Eight matches of each category of competition (Spanish national U-14 championship, Spanish national U-16 championship, Spanish national U-18 championship, Spanish senior 2nd national division, Spanish senior 1st national division, and senior international level (World Championship)) were analyzed (Table 1). The sample was intentional and included matches between the top 12 and top 24 teams in the 2006 Spanish National Championship and the 2006 World Championship, respectively. No more than two matches per team were included. The ethics commission of the principal researcher pre-approved the study project, in compliance with the principles of Helsinki's Declaration.

Table 1. *Sample used for attack technique.*

Sample	Levels						Total
	U-14	U-16	U-18	2nd national division	1st national division	International level	
Matches	8	8	8	8	8	8	48
Sets	29	35	32	27	31	33	187
Sequences	1813	1908	1873	2195	2043	1638	11470

The design of the study was descriptive punctual, nomothetic, multidimensional, inter- and intra-group correlational (Anguera, Blanco & Losada, 2001). The variables of the study were: age group and level of competition (U-14, U-16, U-18, senior 2nd national division, senior 1st national division, and senior international level), game phase (side-out, and counter-attack), attack technique (power, tip, off-speed, and other), attack performance (on a scale from 0 to 4), attack zone (net was divided into nine equal zones, two zones were considered outside of the net, and back-row was divided into three equal zones) (Figure 1), destination zone (court was divided into six equal zones), and attack tempo (first-tempo, second-tempo, third-tempo, second contact attack, and attacks at the first contact of the sequence of game). For the categories of attack performance, an efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-4)), a point-to-error ratio, and an efficiency value (points or perfect actions minus errors) were calculated.

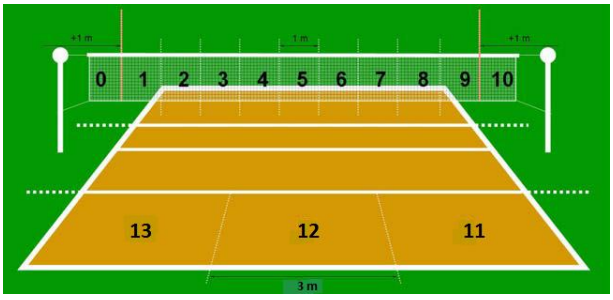

Figure 1. Side area of attacking over the net.

All recordings were taken in public, official sporting events without any influence on the game. All matches were recorded with a video camera located at the end of the court at a height above the net by researchers or by coaches. The variables registered are part of the observation instrument (Observation Instrument of Techniques and Efficacy in Volleyball) that was designed and validated by Palao and Manzanares (2009) and Palao, Manzanares, and Ortega (2015), respectively. The observation was done by a single observer, who held a sports science degree, had the highest coaching certification in Spain, and had more than five years of experience as a coach and volleyball analyst. The observer was trained with the observation instrument before beginning the study (Palao & Manzanares, 2009). After the training period, inter- and intra-observer reliability were calculated (Cronbach's Alpha). To calculate the intra-observer reliability, another researcher was used as a reference. This researcher also held a sports science degree, had the highest coaching certification in Spain, and had more than ten years of experience. An intra-observer reliability of 0.82 and an inter-observer reliability of 0.96 (Kappa-Cohen test) were calculated.

A descriptive analysis (occurrence, occurrence percentage, means, standard deviation, and coefficient of performance values) and an inferential analysis were made. The Kolmogorov-Smirnov test was used to analyse the normality of the sample, the Chi-square test was used to study the differences in

each category, and the Mann-Whitney U was used to analyse the differences between categories. The analyses were done with the SPSS 21 software. The level of significance was established at $p<0.05$.

RESULTS

In the performance of attack technique (Table 2), the occurrence of power spikes that do not allow the opponent attack was significantly higher in U-14 and U-16 and lower in senior international level. The attack-point had a significantly lower occurrence in U-14 and U-18 and higher in senior 1st national division and senior international level. With the tips, the occurrence of errors was significantly higher in U-14 and lower in international level. The tips that limit opponent offense options were significantly lower in U-14 and U-16 and higher in senior international level. Regarding the use of other techniques, the attacks that did not allow opponent attack were significantly lower in U-14 and U-16 and higher in U-18 and senior levels. The occurrence of attacks that limit the opponent's counterattack was significantly higher in U-14 and U-16 and lower in U-18 and senior levels.

In the efficacy of attack technique according to the game-phase (Table 3), the power spike and the tip had significantly higher efficacy in senior 1st national division and senior international level than in U-14 and U-16 in side-out 1. In counter-attack, the efficacy of other techniques was significantly lower in senior international level than in U-14, U-16 and senior 2nd national division.

Table 2. *Performance of attack technique according to level of competition.*

Performance	U-14		U-16		U-18		2nd national division		1st national division		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Power spike												
Error	209	18.7	220	18.3	223	17.6	291	18.7	267	17.0	212	16.4
All attacks allowed	55	4.9	80	6.7	108^{+}	8.5	105	6.7	98	6.2	54^{-}	4.2
Limited attacks	360	32.2	343	28.6	432^{+}	34.2	504	32.4	457	29.0	380	29.4
No attack allowed	138^{+}	12.3	121^{+}	10.1	100	7.9	115	7.4	116	7.4	67^{-}	5.2
Point	357^{-}	31.9	435	36.3	401^{-}	31.7	542	34.8	636^{+}	40.4	579^{+}	44.8
Tip												
Error	36^{+}	21.4	27	13.9	27	12.9	28	11.4	27	11.3	8^{-}	4.4
All attacks allowed	13	7.7	13	6.7	10	4.8	14	5.7	13	5.5	9	5.0
Limited attacks	51^{-}	30.4	61^{-}	31.4	89	42.6	106	43.3	109	45.8	99^{+}	54.7
No attack allowed	22	13.1	28	14.4	25	12.0	25	10.2	19	8.0	15	8.3
Point	46	27.4	65	33.5	58	27.8	72	29.4	70	29.4	50	27.6
Off-speed spike												
Error	10	10.3	10	7.8	16	9.9	8	4.4	8	7.3	7	8.4
All attacks allowed	4^{-}	4.1	19	14.8	18	11.1	25	13.8	17	15.5	7	8.4
Limited attacks	47	48.5	54	42.2	78	48.1	98	54.1	59	53.6	44	53.0
No attack allowed	11	11.3	16	12.5	18	11.1	15	8.3	5	4.5	5	6.0
Point	25	25.8	29	22.7	32	19.8	35	19.3	21	19.1	20	24.1
Other technique												
Error	47	11.0	36	9.3	14	5.9	13	6.1	6	5.0	7	8.5
All attacks allowed	93^{-}	21.7	112^{-}	28.9	113^{+}	47.5	106^{+}	50.0	70^{+}	57.9	48^{+}	58.5
Limited attacks	210^{+}	49.0	186^{+}	48.1	91	38.2	64^{-}	30.2	33^{-}	27.3	21^{-}	25.6
No attack allowed	34^{+}	7.9	20	5.2	5^{-}	2.1	7	3.3	4	3.3	2	2.4
Point	45	10.5	33	8.5	15	6.3	22	10.4	8	6.6	4	4.9

Note: - o + statistical signification of 0.05 (chi square test). + o – relationship found (positive or negative).

Table 3. *Efficiency of attack technique according to game phase and level of competition.*

Game phase	U-14		U-16		U-18		2nd national division		1st national division		International	
	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef
Power spike												
Side-out	506	2.23[ef]	564	2.27[ef]	592	2.24	765	2.32[ef]	854	2.52[abdf]	746	2.70[abdf]
Counter-attack	613	2.43	634	2.5	673	2.30	792	2.33	720	2.43	546	2.42
Total	1119	2.33	1198	2.39	1265	2.27	1557	2.33	1574	2.48	1292	2.56
Tip												
Side-out	54	1.87[f]	67	2.06[df]	71	2.28[f]	108	2.45[be]	107	2.50[d]	91	2.69[abc]
Counter-attack	114	2.32	128	2.7[f]	138	2.41	138	2.35	131	2.30	91	2.30[b]
Total	168	2.10	195	2.41	209	2.35	246	2.40	238	2.40	182	2.50
Off-speed spike												
Side-out	33	2.27	40	2.60	70	2.21	75	2.09	27	2.07	33	2.30
Counter-attack	64	2.44	88	2.13	92	2.18	106	2.35	83	2.14	50	2.28
Total	97	2.36	128	2.37	162	2.20	181	2.22	110	2.11	83	2.29
Other technique												
Side-out	191	1.79	160	1.73	82	1.55	58	1.59	41	1.61	20	1.35
Counter-attack	237	1.92[c]	226	1.75[cf]	156	1.56[ab]	154	1.63[f]	80	1.43	61	1.36[bd]
Total	428	1.86	386	1.74	238	1.56	212	1.61	121	1.52	81	1.36

Note. [a]p<0.05 in U-14. [b]p<0.05 in U-16. [c]p<0.05 in U-18. [d]p<0.05 in 2nd national division. [e]p<0.05 in 1st national division. [f]p<0.05 in international.

In attack tempo according to the game-phase (Table 4), the occurrence of the 1st tempo attack in side-out and counter-attack phases was significantly higher in U-18 and senior levels than U-14 and U-16. The occurrence of the 2nd tempo attack in side-out was significantly higher in all senior levels than U-14 and U-16. With 3rd tempo attack in side-out, occurence was significantly higher in U-14, U-16, and U-18 and significantly lower in all senior levels. The second contact attack in side-out and counter-attack phase was significantly higher in U-14 and U-16 and lower in senior international level. The efficacy of 3rd tempo attack showed a significantly higher efficacy in side-out in senior international level than the rest of age groups and levels studied. The efficacy of the second contact attacks was significantly higher in U-18 and senior levels than in U-14 in side-out.

With respect to the attack zone (Table 5), the occurrence of attacks in zone 1 was significantly higher in senior 1st national division and senior intenational level and lower in U-14 and U-16. Attacks in zone 5 had a higher occurrence in U-14 and U-16 than senior 1st national division and senior international level. In side-out, U-14, U-16 and U-18 had a significantly lower efficacy than senior international level with attacks in zones 4, 3, 2, and 6.

In the attack direction (Table 6), the occurrence of attack-errors was significantly higher in U-14 and U-16 than the rest of the age groups and levels studied. Occurrence of attacks to zone 5 was significantly lower in U-14 and U-16 and higher in senior 1st national division and senior international level.

Table 4. *Efficiency of attack according to game phase, timing of the attack and level of competition.*

Game phase	U-14		U-16		U-18		2nd national division		1st national division		International	
	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef
1º tempo attack												
Side-out	1	3	-	-	19^{-}	2.79	85^{+}	2.74	132^{+}	2.53	124^{+}	2.83
Counter-attack	-	-	-	-	16	3.06	43^{+}	2.63	45^{+}	2.89	40^{+}	2.95
Total	1		-		35^{-}		128^{+}		177^{+}		164^{+}	
2º tempo attack												
Side-out	-	-	3^{-}	0.67	49^{-}	2.43	125^{+}	2.39^{f}	110^{+}	2.63	148^{+}	2.76^{d}
Counter-attack	12^{-}	2.92	21^{-}	2.90	51^{+}	2.59	50	2.64	50^{+}	2.28	21	3.00
Total	12^{-}		24^{-}		100		175^{+}		160^{+}		169^{+}	
3º tempo attack												
Side-out	731^{+}	2.13^{f}	784^{+}	2.1^{f}	726^{+}	2.13^{f}	760^{-}	2.19^{f}	748^{-}	2.42	591^{-}	2.59^{abcde}
Counter-attack	831^{+}	2.27	863	2.31	870	2.17	913	2.19	776	2.24	607	2.22
Total	1562^{+}		1647^{+}		1596^{+}		1673^{-}		1524^{-}		1198^{-}	
Attack at second touch												
Side-out	52^{+}	1.60^{bdef}	44^{+}	2.27^{a}	20^{-}	2.45	35	2.57^{a}	39	2.87^{a}	24^{-}	2.63^{a}
Counter-attack	106^{+}	1.98	107^{+}	1.91	70	1.86	82	2.02	52^{-}	2.12	32^{-}	2.09
Total	158^{+}		151^{+}		90		117		91^{-}		56^{-}	
Attack at first touch												
Side-out	2	3	-	-	1	3	2	1.50	1	2.00	3	2.00
Counter-attack	81	2.86	86	2.97	53^{-}	2.49	102	2.56	92	2.77	49	2.69
Total	82		86		54^{-}		104		93		52	

Note. ^{a}p<0.05 in U-14. ^{b}p<0.05 in U-16. ^{c}p<0.05 in U-18. ^{d}p<0.05 in 2nd national division. ^{e}p<0.05 in 1st national division. ^{f}p<0.05 in international - o + statistical signification of 0.05 (chi square test). + o – relationship found (positive or negative).

Table 5. *Efficiency of attack according to game phase, zone and level of competition.*

Game phase	U-14		U-16		U-18		2nd national division		1st national division		International	
	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef
Out of zone 4												
Side-out	17^{-}	1.78	24	1.53	63^{+}	2.19	47	1.92	29	1.59	9^{-}	2.19
Counter-attack	7^{-}	1.4	19	1.62	38^{+}	1.90	48^{+}	1.56	33	2.25^{f}	13	1.44^{e}
Total	24^{-}		43		101^{+}		95^{+}		62		22	
Zone 4												
Side-out	246	2.26^{f}	309	2.30^{f}	323	2.12^{f}	386	2.26^{f}	405	2.50	344	2.65^{abcd}
Counter-attack	316	2.36	394	2.47	449	2.03	442	2.29	415	2.37	342	2.26
Total	562		703		772		828		820		686	
Zone 3												
Side-out	143	2.05^{def}	177	2.27^{f}	158	2.28^{f}	215	2.5^{af}	184	2.71^{a}	148	2.81^{abcd}
Counter-attack	438	2.42	365	2.42	235	2.69	207	2.48	156	2.43	90	2.86
Total	581		542		393		422		340		238	
Zone 2												
Side-out	163	2.27^{f}	162	2.36^{f}	149	2.66	252	2.38^{f}	289	2.27	273	2.66^{abd}
Counter-attack	120	2.15	154	2.41	188	2.36	271	2.33	231	2.20	161	2.49
Total	283		316		337		523		520		434	
Out of zone 2												
Side-out	15	1.71	10	1.63	17	1.40	14	1.98	9	1.62	5	1.83
Counter-attack	6	1.89	5^{-}	1.33	16	1.87	20	1.59	21^{+}	1.60	8	1.70
Total	21		15		33		34		30		13	
Backrow, zone 1												
Side-out	48	1.99^{c}	38	1.65	48	1.69^{a}	34^{-}	2.13	54	2.21	42	1.94
Counter-attack	17^{-}	2.44	31^{-}	1.76	46	2.12	53	1.64	59^{+}	2.09	58^{+}	2.41
Total	65^{-}		69^{-}		94		87		113^{+}		100^{+}	
Backrow, zone 6												
Side-out	98^{+}	2.05^{c}	75^{+}	1.81^{cf}	29^{-}	1.32^{af}	46^{-}	1.67^{f}	54	2.09	57	2.61^{bcd}
Counter-attack	93	1.92	77	1.95	61^{-}	1.58	133^{+}	1.97	91	2.02	60	1.73
Total	191^{+}		152		90^{-}		179		145		117	
Backrow, zone 5												
Side-out	56^{+}	1.47^{e}	36^{+}	1.68^{e}	28	1.45^{e}	13^{-}	1.23	6^{-}	2.5^{abc}	12^{-}	2.14
Counter-attack	33^{+}	1.83	32	1.67	27	1.76	16	1.31	9^{-}	1.37	16	1.49
Total	89^{+}		68^{+}		55		29^{-}		15^{-}		28^{-}	

Note. ^{a}p<0.05 in U-14. ^{b}p<0.05 in U-16. ^{c}p<0.05 in U-18. ^{d}p<0.05 in 2nd national division. ^{e}p<0.05 in 1st national division. ^{f}p<0.05 in international - o + statistical signification of 0.05 (chi square test). + o – relationship found (positive or negative).

Table 6. *Efficiency of attack according to destination zone and level of competition.*

Destination	U-14		U-16		U-18		2nd national division		1st national division		International	
	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef
Out	104	0.00	107	0.00	110	0.00	107	0.00	111	0.00	86	0.00
Zone 1	286^{-}	2.73	378	2.80	384	2.68	434	2.69	462^{+}	2.80	356	3.00
Zone 2	75	2.43	96	2.61^{e}	106^{+}	2.35	116	2.57	51^{-}	2.29^{b}	69	2.52
Zone 3	177^{+}	2.49	158	2.50	150	2.44	167	2.44	135	2.45	65^{-}	2.38
Zone 4	63	2.41	76	2.47	71	2.44	97	2.39	66	2.59	65	2.51
Zone 5	321^{-}	2.79^{f}	333^{-}	2.69^{f}	342	2.59	446	2.81^{f}	460^{+}	2.77^{f}	377^{+}	2.96^{abde}
Zone 6	670	2.33^{d}	656	2.33^{d}	632	2.21	723	2.21^{abf}	708	2.40	595	2.37^{d}
Net	118^{+}	0.00	103^{+}	0.00	75	0.00	84	0.00	48^{-}	0.00	25^{-}	0.00

Note. ^{a}p<0.05 in U-14. ^{b}p<0.05 in U-16. ^{c}p<0.05 in U-18. ^{d}p<0.05 in 2nd national division. ^{e}p<0.05 in 1st national division· ^{f}p<0.05 in international - o + statistical signification of 0.05 (chi square test). + o – relationship found (positive or negative).

DISCUSSION

Different age groups and levels had different attack performance. Attacks that influence the opponent's defense and did not allow a counterattack had a significantly higher occurrence in U-14 and U-16 and lower in the higher of levels of competition. Comparatively, the attack-point had a significantly lower occurrence in U-14 and higher in the rest of the levels of competition. The reason may lie in the abilities of the team to build their play's sequence, which are lower in early stages of competition (Ureña, León & González, 2013; Ureña, Vavassori, León & González et al., 2011). These could be influenced by skills, such as physical, technical, tactical and decision making, that develop in higher age groups and levels (Araujo, Afonso & Mesquita, 2011; Berry & Abernethy, 2009). The attack is a complex action which requires experience and control on several parts (Selinger & Ackermann-Blount, 1985; Valadés et al., 2013), in addition to coordination between players to finish the sequence as best they can (Bergeles & Nikolaidou, 2011; Eom & Schutz, 1992b). Previous studies showed that the attacking action is a predictor of success in the results of the game in senior levels (Castro, Cavalli, Alves & Grecco, 2014; Castro, Souza & Mesquita, 2011; Drikos & Vagenas, 2011; Marcelino & Mesquita, 2006; Marcelino, Mesquita, Castro & Sampaio, 2008; Palao, Santos & Ureña, 2004; Rodríguez-Ruiz et al., 2011; Stamm, Stamm & Koskel, 2008). In U-18, there is still not a perfect linkage of each action of the sequence (Costa et al., 2011a); but at physical and technical performance players had slightly lower values than senior levels (Inkinen et al., 2013). The results found are similar to the bibliography. Higher levels of competition had higher attack efficicacy (Drikos & Vagenas, 2011; Eom & Schutz, 1992a; Inkinen et al., 2013; Marcelino & Mesquita, 2006; Palao et al., 2004; Rodríguez-Ruiz et al., 2011).

The power spike and the tip showed higher efficiency in side-out in senior categories. In youngest age groups, these techniques were more efficient in counter-attack. The results showed how at higher levels of competition had a greater ease in side-out rather than in counterattack (Palao et al., 2005). In the early stages, the serve difficults teams' offense (Croitoru, 2014; Dávila-Romero, García-Hermoso & Saavedra, 2012). However, in older ages groups, the reception balances the serve and players' improvement through maturity and training and allows teams to execute better attacks (Grgantov, Katic & Jankovic, 2006; Lidor & Ziv, 2010a; Stamm et al., 2003; Stamm et al., 2004). In young age groups, there are more situations in which players use other techniques to send the

ball to the opponent court. Their lower technical skills and game knowledge did not allow them to solve these situations (Duncan et al., 2006; Grgantov et al., 2006). Contrastingly, in the early stages of U-14 and U-16, there is a significantly higher efficiency in the use of these techniques compared to higher levels. All of this confirms a lower capacity to control the ball and the situations in a game in the early stages of training (Ureña et al., 2011, 2013). The use of the tip presented a different tendency. Their frequency of use is similar through the different stages (10%), but at the senior levels, the tip has fewer mistakes and higher occurrence of being able to limit the attack by the opponent. Therefore, although, the tip had a lower occurrence than power spike (~11%), it becomes a useful alternative to surprise the opponent at senior levels.

The use of 1st and 2nd attack tempo increased when the level of competition was higher. These results are similar to previous studies in high performance levels that show the dependence of the quicker attack tempo on prior actions of the game (reception/defense and setting) (Bergeles & Nikolaidou, 2009; Castro & Mesquita, 2010; Castro et al., 2011; Palao & Echeverría, 2008; Palao et al., 2005). The 1st tempo had a significantly higher occurrence in high levels of competition, both in side-out and counterattack, while the 2nd attack tempo had an occurrence significantly higher in high levels in side-out. The 3rd attack tempo shows significant higher efficacy in higher levels of competition that in lower levels in side-out, not in the counter-attack. In side-out, older age groups had better conditions to prepare the attack and they had higher efficiency in all attack tempo (Inkinen et al., 2013, Palao et al., 2005). It should be added that the fastest attacking tempo, 1st tempo, needs good coordination of the players (Bergeles & Nikoliudou, 2011; Costa et al., 2014; Eom & Schutz, 1992a) and better efficiency in the prior actions of reception and setting. Data show players at senior level had the ability to execute 1st attack tempo in counterattack. Another aspect to consider is players at senior levels need a quicker attack to overcome the opponent's block (Palao et al., 2004; Rodríguez-Ruiz et al., 2011). Attacks at the 2nd contact, usually made by the setter, have a significantly higher occurrence in U-14 and U-16 both in side-out and counterattack. Its use is significantly lower in senior international level (<5%), although with higher efficiency. This could happen due to higher setters' game knowledge, power spike is the action that correlate more with the result (Bergeles et al., 2009; Bergeles & Nikolaidou, 2011; Castro et al., 2011; Costa et al., 2014; Drikos & Vagenas, 2011; Eom & Schutz, 1992a; Marcelino et al., 2014; Palao et al., 2005), and they only used when it can surprise the opponent.

Third attack tempo had a significantly higher efficacy in side-out in senior international level than the rest of level of competition (World Championship). The highest level of competition has the best attackers in the world, with higher and stronger spikes (Malousaris et al., 2008). The studies about growth and development allow us to know that teams from adolescence who stand out in women's volleyball are those with taller and stronger players (Grgantov et al., 2006; Malina et al., 2004; Stamm et al., 2003) and the spike becomes the main variable that highlights them (Stamm et al., 2008). Another aspect evolves through the developmental stages was the attack zone. No differences were found find in the front-row zones. However, at a higher level of competition, there was a higher use of the zone 1 to attack in senior levels. The back-row attack is more demanding for the setter and the spiker in terms of physical condition and coordination (Selinger & Ackermann-Blount, 1985). Zone 1

is where opposite hitters play in their back-row rotations. In higher levels of competition, those hitters are highly employed to increase the attack options when the setter is in front-row (Mesquita & César, 2007; Palao et al., 2005). In younges age group and senior 2nd national division), the attacks from the back-row in zone 6 have a significantly higher occurrence in side-out and counter-attack, respectively. The use of this zone could be due to the efficiency of the reception/defense did no allow setters to pass the ball out of their ideal zones to play (Ureña et al., 2011, 2013). An alternative option may be the pass to the nearest spiker, which eases the play and does not require higher precision and control of the pass (McGown, Fronske & Moser, 2001), making zone 6 the more accessible zone when the setter needs to pass from separate zones to the net.

CONCLUSIONS

As competition level increases, performance in power spike, tip, attacks at the 2nd contact, the use of quick attacks, and attacks from back-row zones increase. In all levels studied, the main attack technique used was the power spike, which has a higher efficiency in side-out than in counterattack. In lower levels, the efficiency of techniques power spike and tip are higher in the counterattack. The results of this study show the performance profile of attacks in women's volleyball, from the lowest level of competition to the highest. This information could help coaches to analyze and evaluate this game action in their players and develop a strategic plan for each stage of development. Future studies are necessary and should consider the physical incidence of the attack, tactical aspects, psychological, physical capacities, difference between player's roles, etc.

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