Evolution of setting efficacy and execution in women's volleyball according to age group and level of competition

Evolución de la forma de ejecución y eficacia de la colocación en voleibol femenino en función del grupo de edad y el nivel de competición

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Abstract

Purpose: The aim of this study was to analyze the technical profile of performance in setters according to the age group and competitive level in women's volleyball. Material and methods: a total of 9,977 game phases from the under-14 age group to the international level were analyzed. The variables analyzed were: age group & level of competition, game phase, reception/dig efficacy, setting technique, setting zone, distance from the net in which the setting was executed, starting position of the setter, and setting efficacy. Results: as the level of competition increased, there was an increase in the frequency of the jump set and its efficacy, and the setting was less conditioned by the previous action (service reception/defense). Conclusion: there was a relationship between the level of competition the quality of the set and the frequency of use of the jump set. The results provide normative profiles of the set through the different stages of development of volleyball female players.

Keywords: Team sport, performance, match analysis, developmental stage.

Resumen

Propósito: El objetivo del estudio del estudio fue analizar el perfil técnico de rendimiento de las colocadoras en función de su grupo de edad y nivel de competición. Material y métodos: Se analizaron un total de 9,977 acciones de juego desde categoría infantil nacional (U-14) a categoría senior internacional. Las variables analizadas fueron: grupo de edad y nivel de competición, fase de juego, eficacia de la recepción/defensa, técnica de colocación, zona de colocación, distancia de la red a la que la colocación fue ejecutada, zona del campo en la que se encuentra el colocador en la rotación, y eficacia de la rotación. Resultados: Cuando el nivel de competición se incrementa, hay un incremento en la frecuencia de colocaciones en salto y en la eficacia de la colocación, y las colocaciones están menos condicionadas por las acciones previas (recepción/defensa). Conclusiones: Hay una relación entre el nivel de competición y la calidad de la colocación y la frecuencia de uso de la colocación en salto. Los resultados proporcionan el perfil de rendimiento de la colocación a través de las diferentes etapas de desarrollo de la jugadora de voleibol.

Palabras clave: Deporte de equipo, rendimiento, análisis de partidos, etapa de desarrollo.

Introduction

In team sports, players learn and improve their skills through practice along with their developmental process (Stamm et al., 2003). The reasons why they improve lie within the accumulation of training time, technical control gained, and changes in physical maturation (Elferink-Gemser et al., 2007; Grgantov et al., 2006; Malina et al., 2004; Rikberg & Raudsepp, 2011; Viviani et al., 2004). In team sports, all game actions are linked, as the performance of previous actions affects the following (Glazier, 2010). In volleyball, the team with the ball tries to send it over the net in such a way that it contacts the opponent's court or in a way that the opponents cannot control it (Selinger & Ackermann-Blount, 1985); meanwhile, the opponent tries to neutralize the ball and build their offense (Fédération Internationale de Volleyball [FIVB], 2021). Throughout the training process, the growth and development of the players directly impacts the training methods required to optimize efficacy of performance. Currently, the majority of information available which regards to training and competition is related to seniors and higher levels of competition. There is less information regarding the link between physical development changes and the most effective training methodologies.

In volleyball, game interactions and actions are constrained by the height of the net and the limits in the number of ball contacts allowed (FIVB, 2021). These restrictions drive the game to a cyclical pattern of actions (Selinger & Ackermann-Blount, 1985). The first action of the cycle tries to neutralize the opponent's action (serve or attack) and put the ball close to the net. The second action, setting, intends to prepare the attack. The third action, attacking, intends to win the point. This way, the setter is a key figure throughout the sequence, as the player who organizes the attack (Matias & Greco, 2011). The cyclical pattern of the actions in game means actions are affected by one another (Afonso et al., 2008; Eom & Schutz, 1992a, 1992b). Therefore, setting performance is linked to receiving performance (González-Silva et al., 2016; Marcelino et al., 2014; Palao & Ahrabi-Fard, 2014; Silva et al., 2014b). The set is also linked to the attack, the action with the highest correlation to the final performance of the game (Silva et al., 2016). During the developmental process, the relationship between the setter and the hitters improves (Araujo et al., 2012). Setters make better tactical choices (Alexandros & Athanasios, 2017; Gil et al., 2013), and they use techniques that accelerate the offense, such as the jump-sets (Katsikadelli, 1995; Palao & Echeverría, 2008, Sotiropoulos et al., 2019).

Interactions that happen in the game are affected by a rotation rule, which establishes that all players must go through each zone of the court (FIVB, 2021). This rule affects the actions made by setters and hitters, like first-tempo attacks and back row attacks (Palao et al., 2005), and coincidentally the efficiency in the whole game. It is possible to differentiate two situations in the game: rotations with the setter in the front row and rotations with the setter in the back row (Palao et al., 2005). Current information shows a trend in setters from elite and senior levels to accelerate the game (attack tempo) and to use a higher number of players in the offense (front and back row players) (Alexandros & Athanasios, 2017; González-Silva et al., 2016; Marcelino et al, 2014; Rocha et al., 2020). However, it is not clear how the attacking game has evolved from lower to higher levels. The information about zones of setting-spiking, types of setting and its efficiency in every competition level should enhance knowledge of how the training process takes effect and provide guidelines for training coaches. The aim of this paper was to study the technical profile of performance in setters according to the age group and competition level in women's volleyball.

Materials and methods

Sample

The sample included 9,977 sequences played in 187 sets, corresponding to 48 volleyball matches across different age groups and levels of competition (U-14, U-16, U-18, 2nd national division, 1st national division, and international level). There were eight matches from each level of competition. Table 1 described the distribution of the sample. The sample was intentional and the sequences analysed belong to matches of the top twelve teams from every championship in the 2005/2006 season. No more than three matches per team were included. In U-16, U-18 and senior competitions, the quarterfinals, semifinals, consolation finals, and finals were analyzed. In U-14, due to the format of competition, besides semifinals, consolation final, and final, four matches were randomly selected from the four groups of three teams that were played before semifinals were analyzed. The ethics commission of the principal researcher pre-approved the study project, in compliance with the principles of Helsinki's Declaration.

Table 1. Distribution of the sample for the different age groups and levels of competition (women's indoor volleyball).z

Sample	Levels						Total
	U-14	U-16	U-18	2nd national	1st national	International	
Matches	8	8	8	8	8	8	48
Sets	29	35	32	27	31	33	187
Sequences	1651	1737	1789	1337	1897	1566	9977

Design

The design characteristics of the observational study were: descriptive, punctual, nomothetic, multidimensional, and inter- and intra-group (Anguera et al., 2001). The variables discussed in 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), reception/defense efficacy (on scale from 0 to 3), reception/defense zone (the court was divided into six equal zones), setting technique (jump set, standing set, forearm sets, one-hand set, and other techniques), setting efficacy (on scale from 0 to 3), setting zone (net was divided into nine equal zones, two zones were considered outside of the net (Figure 1)), distance from the net where the set is made (0 to 1.5 metres from the net, 1.5 metres to three metres from the net, and more than three metres from the net), and starting position of the setter (rotation position [FIVB, 2021]).

Reception/defense and setting performance were evaluated in relation to the success of the action and the options it gave to the team. The following four performance levels were differentiated: error, no attack options, limited attack options, and maximum attack options (Palao et al., 2015). For the categories of reception/defense and setting performance, an efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-3)), a maximum attack options-to-error ratio, an efficacy percentage (percentage of the maximum attack options) and an efficiency percentage (percentage of maximum attack options actions minus percentage of error actions) were calculated.

Procedure and equipment

The variables registered are part of the observation instrument (Observation Instrument of Techniques and Efficacy in Volleyball, TEVOL for its acronym in Spanish) that was designed and validated by Palao and Manzanares (2009)

and Palao et al. (2015), respectively. All recordings were made in public sporting events without any influence on the game. All of them were official matches and were recorded with a video camera. The observation was made by a single observer (sports science degree, highest national volleyball coaching certification, and more than five years of experience as a coach and volleyball analyst). After the training period, inter- and intra-observer reliability were calculated (Cronbach's Alpha). To calculate the inter-observer reliability, another researcher was used as a reference (sports science degree, highest national coaching certification, and more than ten years of experience). To calculate the intra-oberver reliability, the observer was tested with the same sample spaced before and at the end of the observation (set of a match). The inter-observer reliability was 0.82 and the intra-observer reliability was 0.96 (Kappa-Cohen test).

Statistics

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 analyze the normality of the sample (parametric or non-parametric). Due to the data being parametric, the Chi-square test was used to study the differences in each category regarding performance of the actions and way of execution (categorical data). The Mann-Whitney U was used to analyze the differences between categories in the efficacy variables between games (continaous variables). Two databases were used to perform the inferential analysis. Each database has a different unit of analysis (game sequence vs. sets of the game). The Chi-square test was implemented on the database with the sequence of the actions, performance, and way of execution. The Mann-Whitney U was used with the database with the efficacy of the set in the different matches studied. The analysis was done using SPSS 21 software, and the level of significance was established at p<.05.
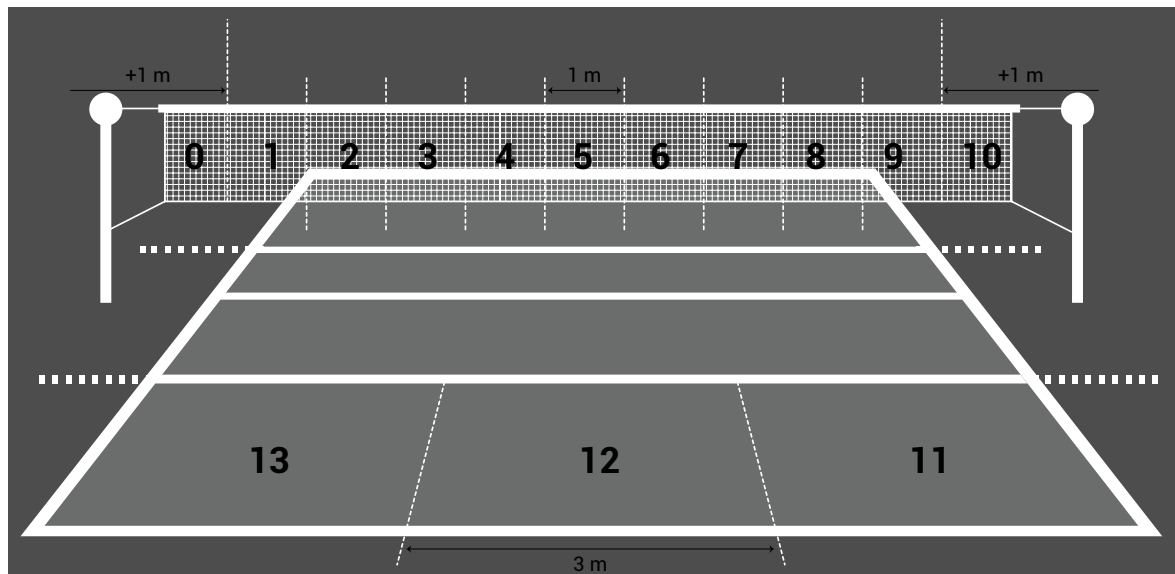
Figure 1. Setting zones over the net (Palao and Manzanares, 2009).

Results

Regarding the setting technique (Table 2), the jump set had a significantly lower occurrence and efficacy in U-14, U-16 and U-18 levels than the senior levels of competition. The standing set had a significantly higher occurrence in U-14 and U-16 than the U-18 and senior levels. Efficacy, the percentage of points, efficiency and ratio were significantly higher in senior levels than in U-14, U-16, and U-18. The percentage of errors in U-14 was significantly higher than in the rest of the levels of competition. The forearm set had a significantly higher occurrence in U-14 and U-16 and lower in U-18 and senior levels. The forearm set had a significantly lower coefficient of efficacy in U-14 and U-16 than in the senior 1st national division and senior international level. The one-hand technique was not used in U-14 and U-16 and had a significantly lower efficacy in U-18 than in senior international level.

With respect to the setting performance (Table 3), the jump set showed a significantly higher occurrence of errors and sets that did not allow the attack in U-14 and U-16 than in U-18 and senior levels. The jump sets that allowed all attack were significantly lower in U-14, U-16, and U-18 and significantly higher in senior international level. The standing set had a significantly higher occurrence of errors in U-14 than in the senior 1st national division. The standing sets that limited the attack options had a significantly higher occurrence in U-14 and U-16 than in senior levels. The forearm set had a significantly lower occurrence of errors in

senior international level and a significantly higher occurrence of passes that could not allow the spike in U-14 than in senior levels. The forearm set that allowed all attack options had a significantly lower occurrence in U-14 and higher in U-18 and senior levels.

Regarding the setting techniques and the game phase (Table 4), the jump set showed a similar trend in the side-out phase and the counter-attack phase. There were a significantly higher number of errors and sets that did not allow attack options in U-16 and U-18 competitions when compared to the senior international level. The sets that limited attacks options had a significantly higher occurrence in U-14, U-18 and senior 2nd national division and significantly lower occurrence in senior international level. The setting that allowed all attack options occurred much less in U-14, U-16, and U-18 than in senior international level. The standing set showed a similar trend in the side-out phase and the counter-attack phase. The standing sets that limited attack options occurred much more frequently in U-14 and U-16 level than in senior international level. The standing set that allowed all attack options had a significantly higher occurrence at the international level than in U-14 and U-16 level. The forearm set, in side-out, showed a significantly higher occurrence of sets that could not allow the attack in U-14, U-16, and U-18 competitions and significantly lower in senior levels. The forearm sets that allowed all attack options, both in side-out and counter-attack phases, had a significantly lower occurrence in U-14 and higher in senior international level.

Table 2. Efficacy of setting technique according to levels of competition (women's indoor volleyball).

Setting technique	U-14		U-16		U-18		2nd national		1st national		International	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Jump set												
Coefficient	2.08[def]	0.44	1.86 [def]	0.23	2.39 [def]	0.04	2.63[abcf]	0.07	2.67 [abcf]	0.03	2.80 [abcde]	0.07
Efficacy (%)	25 [def]	21.51	22.5 [def]	10.55	51.27 [def]	2.37	65.18 [abcf]	5.93	69.36 [abcf]	3.00	81.88[abcde]	6.59
Error (%)	6.25	12.5	9.42	6.74	4.07	1.68	0.68	0.68	0.5	0.46	0.44	0.43
Efficiency	18.75 [def]	32.18	13.07 [def]	15.13	47.2 [def]	2.09	64.5 [abcf]	6.24	68.86 [abcf]	3.02	81.44[abcde]	6.78
Ratio	1:21.9[def]	26.18	1:17.8[def]	12.60	1:49.2[def]	2.07	1:64.8[abcf]	6.08	1:69.1[abcf]	3.00	1:81.7[abcde]	6.68
Occurrence	22[-]		36[-]		277[-]		717[+]		787[+]		660[+]	
Frequency	1.3[def]		2.2		15.5 [def]		35.2		41.5 [def]		42.5	
Stand set												
Coefficient	1.95[cdef]	0.05	2.11[def]	0.02	2.18[a]	0.01	2.29[ab]	0.09	2.27 [ab]	0.11	2.41 [ab]	0.13
Efficacy (%)	10.1[def]	3.53	19.07 [def]	2.06	23.2[df]	2.35	35.76[ab]	4.63	30.2 [ab]	8.87	48.04 [abc]	11.88
Error (%)	5.12[bcdef]	1.36	2.47[a]	0.95	1.74 [a]	1.64	2.30 [a]	1.43	1.04 [a]	1.11	1.60 [a]	1.62
Efficiency	4.97[def]	4.28	16.6 [def]	2.11	21.46[df]	1.39	33.46[abc]	6.03	29.16[ab]	9.60	46.44[abc]	10.56
Ratio	1:7.53[def]	3.87	1:17.8[def]	2.03	1:22.3[df]	1.74	1:34.61[abc]	5.33	1:29.68[ab]	9.22	1:47.24[abc]	11.21
Occurrence	788		986[+]		916[+]		792[-]		735[-]		583[-]	
Frequency	47.7		57.0		51.3		39.1		38.8		37.5	
Forearm set												
Coefficient	1.70[df]	0.05	1.72 [df]	0.03	1.80	0.12	1.78	0.11	1.89[ab]	0.13	1.91[ab]	0.09
Efficacy (%)	3.80	4.08	3.22	0.45	2.98	1.94	7.58	3.27	8.38	9.33	8.72	4.05
Error (%)	2.17f	1.34	1	0.72	1.22	1.48	2.32 [f]	1.50	1.80	1.09	0.24[ad]	0.6
Efficiency	1.62	4.17	1.82	1.47	1.76	1.42	5.26	3.03	6.58	10.36	8.48	4.43
Ratio	1:2.71	4.07	1:2.72	0.63	1:2.37	1.53	1:6.42	3.06	1:7.48	9.85	1:8.6	4.23
Occurrence	809+		637[+]		543		456[-]		313[-]		271[-]	
Frequency	49.0		36.9		30.4		22.4		16.6		17.4	
One-hand set												
Coefficient	-	-	-	-	0.33[f]	0.58	1.55	1.03	1.5	1.03	2.35[c]	0.57
Efficacy (%)	-	-	-	-	-	-	5	11.55	33.32	50.92	50	32.27
Error (%)	-	-	-	-	66.67	57.73	0	57.73	41.67	31.93	5	11.18
Efficiency	-	-	-	-	-66.67	57.73	5	54.16	-8.35	73.92	45	44.72
Ratio	-	-	-	-	1:-33.33[f]	28.87	1:5	29.86	1:12.49	59.90	1:47.5[c]	41.83
Occurrence	-		-		3		10		10		15+	
Frequency	-		-		0.2		0.5		0.5		1.0	

Table 2. Efficacy of setting technique according to levels of competition (women's indoor volleyball) (Continued).

Other techniques												
Coefficient	0.93	0.17	0.83	0.11	0.87	0.37	0.00	0.19	0.99	0.12	0.88	0.13
Efficacy (%)	-	-	-	-	-	-	27.5	0.00	-	-	-	-
Error (%)	19.82	23.47	31.02	10.24	27.27	27.04	-27.5	25.85	13.1	8.83	25.24	19.01
Efficiency	-19.82	23.47	-31.02	10.24	-27.27	27.04	0.00	25.85	-13.1	8.83	-25.24	19.01
Ratio	1:-9.91	11.73	1:-13.63	5.12	1:-13.63	13.52	1:-13.75	12.93	1:-6.55	4.41	1:-12.62	9.51
Occurrence	32		66+		47		55		49		26-	
Frequency	1.9		3.8		2.6		2.7		2.6		1.7	

Note (Mann-Whitney U): [a]*p*<.05 in U-14. [b]*p*<.05 in U-16. [c]*p*<.05 in U-18. [d]*p*<.05 in 2nd national division. [e]*p*<.05 in 1st national division. [f]*p*<.05 in international. + o − statistical signification of *p*<.05 (chi square test). + o − relationship found (positive or negative).
∗ Data was calculated using the sets of the match as unit of analysis.
Legend: Coefficient: efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-3)); Ratio: a maximum attack options-to-error ratio, Efficacy (%): percentage of the maximum attack options; Errors (%): percentage of the error options; Efficiency (%): percentage of maximum attack options actions minus percentage of error actions; Occurrence: total of actiosn; Frequency: total of actions per set

Table 3. Performance of setting technique according to levels of competition (women's indoor volleyball).

Setting technique	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Jump set												
Error	1	4.5	4+	11.1	10+	3.6	6	0.8	5	0.6	4	0.6
No attack	1	4.5	5+	13.9	8+	2.9	7	1.0	8	1.0	4	0.6
Limit attack	14+	63.6	19+	52.8	117+	42.2	249+	34.7	236+	30.0	123+	18.6
All attacks allowed	6-	27.3	8-	22.2	142-	51.3	455	63.5	538	68.4	529+	80.2
Stand set												
Error	41+	5.2	26	2.6	24	2.6	21	2.7	9-	1.2	13	2.2
No attack	40+	5.1	33	3.3	14-	1.5	14	1.8	15	2.0	12	2.1
Limit attack	625+	79.3	737+	74.7	608	66.4	481-	60.7	515	70.1	245-	42.0
All attacks allowed	82-	10.4	190-	19.3	270	29.5	276+	34.8	196	26.7	313+	53.7
Forearm set												
Error	20	2.5	11	1.7	12	2.2	11	2.4	7	2.2	1-	0.4
No attack	215	26.6	185+	29.0	134	24.7	102	22.4	52-	16.6	42-	15.5
Limit attack	562	69.5	421	66.1	375	69.1	311	68.2	239	76.4	199	73.4
All attacks allowed	12-	1.5	20	3.1	22	4.1	32+	7.0	15	4.8	29+	10.7

Table 3. Performance of setting technique according to levels of competition (women's indoor volleyball) (Continued).

One-hand set													
Error	-	-	-	-	-	66.7	1	10.0	5	50.0	1	6.7
No attack	-	-	-	-	1+	33.3	-	-	-	-	1	6.7
Limit attack	-	-	-	-	-	-	8	80.0	3	30.0	7	46.7
All attacks allowed	-	-	-	-	-	-	1	10.0	2	20.0	6	40.0
Other technique												
Error	10	31.3	26+	39.4	9	19.1	10	18.2	8	16.3	8	30.8
No attack	17	53.1	31	47.0	29	61.7	30	54.5	32	65.3	15	57.7
Limit attack	5	15.6	9	13.6	9	19.1	15	27.3	9	18.4	3	11.5
All attacks allowed	-	-	-	-	-	-	-	-	-	-	-	-

Note: + o − statistical signification of *p*<.05 (chi square test). + o − relationship found (positive or negative).
∗ Data was calculated using the sequences of the rally as unit of analysis.

Table 4. Performance of setting technique according to game phase and levels of competition (women's indoor volleyball).

Phase	Performance	U-14		U-16		U-18		2nd national		1st national		International	
		n	%	n	%	n	%	n	%	n	%	n	%
Jump set													
Side-out	Error	-	-	2+	12.5	7+	5.2	5	1.2	4	0.8	2	0.4
	No attack	-	-	3+	18.8	3	2.2	4	0.9	3	0.6	2	0.4
	Limit attack	3+	100.0	8	50.0	55+	41.0	156+	36.1	140	26.7	91-	19.7
	All attacks allowed	-	-	3-	18.8	69-	51.5	267	61.8	377	71.9	366+	79.4
Counter-attack	Error	1	5.3	2+	10.0	3	2.1	1	0.4	1	0.4	2	1.0
	No attack	1	5.3	2+	10.0	5	3.5	3	1.1	5	1.9	2	1.0
	Limit attack	11	57.9	11	55.0	62+	43.4	93	32.6	96	36.5	32-	16.1
	All attacks allowed	6	31.6	5-	25.0	73-	51.0	188	66.0	161	61.2	163+	81.9
Stand set													
Side-out	Error	21+	6.5	9	2.2	3	0.7	5	1.4	2	0.6	2	0.7
	No attack	22+	6.8	17	4.1	5	1.2	3-	0.8	6	1.8	4	1.3
	Limit attack	254+	78.2	312+	75.9	274	67.3	209	58.2	217	63.6	97-	32.4
	All attacks allowed	28-	8.6	73-	17.8	125	30.7	142+	39.6	116	34.0	196+	65.6
Counter-attack	Error	20	4.3	17	3.0	21	4.1	16	3.7	7	1.8	11	3.9
	No attack	18	3.9	16	2.8	9	1.8	11	2.5	9	2.3	8	2.8
	Limit attack	371+	80.1	425	73.9	334	65.6	272	62.8	298	75.6	148-	52.1
	All attacks allowed	54-	11.7	117	20.3	145	28.5	134+	30.9	80	20.3	117+	41.2

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Table 4. Performance of setting technique according to game phase and levels of competition (women's indoor volleyball) (Continued).

Forearm set													
Side-out	Error	10	2.3	4	1.1	1	0.4	4	2.3	0	0.0	0	0.0
	No attack	121+	27.9	98+	27.7	55	21.8	29	16.6	13-	11.6	4-	4.7
	Limit attack	295	68.1	241	68.1	185	73.4	124	70.9	92	82.1	67	77.9
	All attacks allowed	7-	1.6	11	3.1	11	4.4	18+	10.3	7	6.3	15+	17.4
Counter-attack	Error	10	2.7	7	2.5	11	3.8	7	2.5	7	3.5	1	0.5
	No attack	94	25.0	87	30.7	79	27.1	73	26.0	39	19.4	38	20.5
	Limit attack	267	71.0	180	63.6	190	65.3	187	66.5	147	73.1	132	71.4
	All attacks allowed	5-	1.3	9	3.2	11	3.8	14	5.0	8	4.0	14+	7.6
One-hand set													
Side-out	Error	-	-	-	-	-	-	1	14.3	3	37.5	1	7.7
	No attack	-	-	-	-	1+	100	0	0.0	-	-	1	7.7
	Limit attack	-	-	-	-	-	-	5	71.4	3	37.5	6	46.2
	All attacks allowed	-	-	-	-	-	-	1	14.3	2	25.0	5	38.5
Counter-attack	Error	-	-	-	-	2	100	0	0.0	2	100.0	-	-
	No attack	-	-	-	-	-	-	3	100	-	-	1	50.0
	Limit attack	-	-	-	-	-	-	-	-	-	-	1	50.0
	All attacks allowed	-	-	-	-	2	100	-	-	2	100.0	-	-
Other technique													
Side-out	Error	3	33.3	5	29.4	1	7.7	2	12.5	1	7.7	3	27.3
	No attack	5	55.6	8	47.1	12	92.3	10	62.5	10	76.9	5	45.5
	Limit attack	1	11.1	4	23.5	-	-	4	25.0	2	15.4	3	27.3
	All attacks allowed	-	-	-	-	-	-	-	-	-	-	-	-
Counter-attack	Error	7	30.4	21	42.9	8	23.5	8	20.5	7	19.4	5	33.3
	No attack	12	52.2	23	46.9	17	50.0	20	51.3	22	61.1	10	66.7
	Limit attack	4	17.4	5	10.2	9	26.5	11	28.2	7	19.4	-	-
	All attacks allowed	-	-	-	-	-	-	-	-	-	-	-	-

Note: + o − statistical signification of $p<.05$ (chi square test). + o − relationship found (positive or negative).
∗ Data was calculated using the sequences of the rally as unit of analysis.

Related to the distance from to the net where the set is made (Table 5), the setting executed closer than 1.5 m. from the net in U-14, U-16, and U-18 had a significantly higher number of errors as well as settings that did not allow the attack and the settings that limited the attack options, meanwhile in senior levels those mistakes had a significantly lower occurrence. The sets that allowed all attack options had a significantly lower occurrence in U-14, U-16, and U-18 and significantly higher occurrence in senior levels. The sets from a position between 1.5 and 3 m. of depth from the net, the sets errors, and sets that did not allow the attack had a significantly higher occurrence in U-14 and significantly lower occurrence in senior 1st national division. The sets that limited the attack had a significantly higher occurrence in U-14 and U-16 and significantly lower occurrence in senior international competition. The sets that allowed all attack options had a significantly lower occurrence in U-14 and U-16 and higher in senior levels. The sets completed farther than 3 m. depth from the net had a significantly higher occurrence of the sets that did not allow the attack in U-14 and U-16 and significantly lower occurrence in senior 1st national division and senior international competition. The sets that allowed all attack options had a significantly higher occurrence in senior 1st national division and senior international competition and lower in U-14 and U-16 levels.

Regarding the zone of the net where it was made (Table 6), zones 0 to 7 showed a significantly higher occurrence of sets that did not allow the attack in U-14 and U-16, and significantly lower occurrence in senior 1st national division and senior international level. The sets that limited attack options had a significantly higher occurrence in zones 5, 6 and 7 in U-14, U-16, and U-18, than in senior categories. In zones 5, 6, 7, 8 and 9, the sets that allowed all attack options had a significantly lower occurrence in U-14 and U-16 and significantly higher occurrence in senior levels.

Related to the performance of previous actions (service reception or floor defense) (Table 7), the trends in setting performance between levels were the same with the reception and the defense. There was a significantly higher occurrence of jump settings in senior level; a significantly higher occurrence of stand set in U-14, U-16, and U-18; a significantly higher occurrence of forearm set in U-14 and lower in senior levels. The receptions and defense that did not limit the attack and

allow all attack options had a significantly higher occurrence of the set that allowed all attack options in senior 2nd national division, senior 1st national division and senior international level (Table 8).

Discussion

The occurrence and performance of the different setting techniques varied significantly depending on the levels and there was a relationship between age, level and efficacy. As the age increases, the occurrence of standing sets decreases, and the use of jumping sets increases. The jumping set is a more difficult technique to execute due to the need for higher coordination between players, technical skills and peak physical condition (McGown et al., 2001). That may be the reason why the use of this technique increased in the senior and higher levels, due to their training experience and competition accumulation (García-Alcaraz et al., 2017; Malina et al., 2004; Palao & Ahrabi-Fard, 2014; Stamm et al., 2003).

Other setting techniques, such as the forearm, had a lower occurrence in senior levels of competition. This technique is mostly used in emergency cases when there are no other options (Selinger & Ackermann-Blount, 1985) and the previous action (service reception or floor-defense) limits the offense (Afonso et al., 2008; Palao et al., 2004). These emergency situations occurs when the reception or defense have been less efficient (Dávila-Romero et al., 2012; García-Alcaraz et al., 2014; Ureña et al., 2013) or when the setter can not reach the ball (Elferink-Gemser et al., 2007; Grgantov et al., 2006). This was found in senior levels of competition, where the use of forearm sets is lower due to setters getting the ball from the previous action in better prior passes and they have more experienced setters (João et al., 2007; Inkinen et al., 2013; Zetou et al., 2007).

The one-hand set, which happens during a game when the ball almost passes over the net to the opponent's field (Selinger & Ackermann-Blount, 1985), presented a different tendency. The one-hand set had a significantly higher occurrence in the highest level of competition, senior international level. That may be due to elite setters having more experience, they are taller, and they have great jumping capacities to touch the ball with just one hand without making a technical fault (FIVB, 2021).

Table 5. Performance of setting technique according to depth from the net and levels of competition (women's indoor volleyball).

Depth	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
In 0 to 1.5 metres												
Error	25[+]	5.2	35[+]	5.3	39[+]	5.5	19[-]	1.9	24	2.3	13[-]	1.7
No attack	47[+]	9.8	55[+]	8.4	44	6.2	38	3.8	36[-]	3.4	16[-]	2.1
Limit attack	348[+]	72.3	416[+]	63.3	349	48.9	388[-]	39.0	396[-]	37.3	163[-]	21.3
All attacks allowed	61[-]	12.7	151[-]	23.0	282[-]	39.5	549[+]	55.2	606[+]	57.1	573[+]	74.9
Total	481	100	657	100	714	100	994	100	1062	100	765	100
Coef. Efic.	1.94[bcdef]		2.06[adef]		2.18[adef]		2.50[abcf]		2.52[abc]		2.74[abcd]	
In 1.5 to 3 metres												
Error	25[+]	4.0	11	2.0	11	2.0	8	1.3	7	1.5	4	0.8
No attack	48[+]	7.8	38	7.0	22	3.9	35	5.7	16[-]	3.3	20	4.2
Limit attack	510[+]	82.5	444[+]	81.5	414	73.4	392	63.5	351	73.3	196[-]	41.4
All attacks allowed	35[-]	5.7	52[-]	9.5	117	20.7	182[+]	29.5	105	21.9	254[+]	53.6
Total	618	100	545	100	564	100	617	100	479	100	474	100
Coef. Effic.	1.89[bcdef]		1.99[acdef]		2.11[abf]		2.23[abf]		2.20[abf]		2.45[abcde]	
More than 3 metres												
Error	29[+]	5.2	22	4.2	8[-]	1.6	23[+]	5.5	5[-]	1.4	10	3.2
No attack	178[+]	31.8	161[+]	30.7	120	23.5	80	19.0	55[-]	15.5	38[-]	12.0
Limit attack	348	62.3	327	62.3	347	68.0	286	67.8	255	71.8	218	69.0
All attacks allowed	4[-]	0.7	15[-]	2.9	35	6.9	33	7.8	40[+]	11.3	50[+]	15.8
Total	559	100	525	100	510	100	422	100	355	100	316	100
Coef. Efic.	1.60[cef]		1.65[ef]		1.83[a]		1.76[ef]		1.98[abd]		2.00[abd]	

Note. [a]*p*<.05 in U-14. [b]*p*<.05 in U-16. [c]*p*<.05 in U-18. [d]*p*<.05 in 2nd national division. [e]*p*<.05 in 1st national division. [f]*p*<.05 in international
[+] o [−] statistical signification of *p*<.05 (chi square test). [+] o [−] relationship found (positive or negative).
* Data was calculated using the sequences of the rally as unit of analysis.
Legend: Coefficient: efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-3)).

Table 6. Performance of setting technique according to the side area on the net and levels of competition (women's indoor volleyball).

Performance	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Zone 0-1-2												
Error	8	5.1	10	6.9	4	2.6	8	4.4	7	6.1	4	2.9
No attack	78+	49.4	71+	49	63	41.4	63	35	29-	25.2	26-	18.8
Limit attack	70	44.3	62	42.8	83	54.6	97	53.9	75	65.2	91	65.9
All attacks allowed	2	1.3	2	1.4	2	1.3	12	6.7	4	3.5	17+	12.3
Total	158	100	145	100	152	100	180	100	115	100	138	100
Coef. Efic.	1.33		1.26		1.53		1.61		1.60		1.91	
Zone 3-4												
Error	16	6.2	10	4.4	18	6.3	16	5.7	6-	2.2	7	3.7
No attack	61+	23.7	47+	20.7	34	12	19-	6.8	20-	7.2	9-	4.8
Limit attack	171	66.5	154	67.8	198	69.7	187	66.8	193	69.2	94-	50.3
All attacks allowed	9-	3.5	16-	7	34-	12	58	20.7	60	21.5	77+	41.2
Total	257	100	227	100	284	100	280	100	279	100	187	100
Coef. Efic.	1.65		1.74		1.81		1.99		2.07		2.26	
Zone 5-6-7												
Error	38+	3.9	28	2.6	25	2.2	19	1.4	18	1.4	11-	1.1
No attack	96+	9.8	86+	8.1	61	5.5	51	3.8	42-	3.2	24-	2.4
Limit attack	764+	78.1	771+	72.3	663+	59.2	631-	46.8	598-	45.4	301-	29.7
All attacks allowed	80-	8.2	181-	17	370-	33.1	646+	48	660+	50.1	679+	66.9
Total	978	100	1066	100	1120	100	1347	100	1318	100	1015	100
Coef. Efic.	1.90		2.03		2.22		2.4		2.42		2.61	
Zone 8-9-10												
Error	12	4.6	10	3.5	8	3.5	6	2.7	5	2.7	4	1.9
No attack	38	14.6	53+	18.7	29	12.6	20	8.9	16	8.7	15-	7
Limit attack	201	77.3	201	71	165	71.7	151	67.1	136	73.9	91-	42.5
All attacks allowed	9-	3.5	19-	6.7	28	12.2	48	21.3	27	14.7	104+	48.6
Total	260	100	283	100	230	100	225	100	184	100	214	100
Coef. Efic.	1.65		1.66		1.76		1.90		1.85		2.13	

Note: + o − statistical signification of *p*<.05 (chi square test). + o − relationship found (positive or negative).
Legend: Coefficient: efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-3)).
* Data was calculated using the sequences of the rally as unit of analysis.

Table 7. Setting technique according to the efficiency of prior reception/floor defense and levels of competition (women's indoor volleyball).

Setting technique	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Reception that can´t allow attack												
Jump set	-	-	1	0.9	2	2.7	3+	6.8	3+	9.7	-	-
Stand set	21+	14.5	6	5.4	4	5.5	1	2.3	1	3.2	1	8.3
Forearm	118	81.4	92	82.9	54	74.0	28	63.6	13-	41.9	3-	25.0
One-hand	-	-	-	-	1	1.4	-	-	3+	9.7	-	-
Other technique	6-	4.1	12	10.8	12	16.4	12+	27.3	11+	35.5	8+	66.7
Reception that allows limited options of attack												
Jump set	3-	0.5	7-	1.3	57-	10.3	160+	26.6	176+	31.9	205+	38.8
Stand set	261	47.0	275	50.4	301	54.2	288	47.8	270	48.9	226	42.7
Forearm	290+	52.3	261+	47.8	197	35.5	144-	23.9	100-	18.1	83-	15.7
One-hand	-	-	-	-	-	-	6	1.0	4	0.7	13+	2.5
Other technique	1	0.2	3	0.5	0	0.0	4	0.7	2	0.4	2	0.4
Reception that allows all attacking options												
Jump set	0-	0.0	9-	6.2	76-	42.2	270+	78.0	345+	82.7	257+	78.1
Stand set	43+	65.2	135+	92.5	104+	57.8	74-	21.4	71-	17.0	72-	21.9
Forearm	23+	34.8	2	1.4	-	-	1-	0.3	-	-	-	-
One-hand	-	-	-	-	-	-	1	0.3	1	0.2	-	-
Other technique	-	-	-	-	-	-	-	-	-	-	-	-
Floor defense that can´t allow attack												
Jump set	1	0.9	1	0.9	0	0.0	1	1.0	1	1.4	-	-
Stand set	11	9.5	11	8.3	3	2.6	6	5.8	2	2.9	1	2.1
Forearm	88	75.9	84	62.0	86	75.4	69	66.3	39	56.5	32	68.1
One-hand	-	-	-	-	1	0.9	1	1.0	2	2.9	-	-
Other technique	16-	13.8	39	28.9	24	21.1	27	26.0	25	36.2	14	29.8
Floor defense that allows limited options of attack												
Jump set	9-	1.4	6-	1.0	61	9.5	99+	14.0	100+	16.1	108+	20.8
Stand set	358	55.6	371+	63.9	370	57.5	380	53.7	351	56.5	257-	49.4
Forearm	271+	42.1	197	33.9	202	31.4	213	30.1	159-	25.6	152	29.2
One-hand	-	-	-	-	1	0.2	3	0.4	-	-	2	0.4
Other technique	6	0.9	7	1.2	10	1.6	12	1.7	11	1.8	1-	0.2
Floor defense that allows all attacking options												
Jump set	9-	7.4	13-	6.2	82-	37.1	183+	79.6	162+	78.6	91+	77.1
Stand set	94+	77.7	193+	92.3	136+	61.5	47-	20.4	41-	19.9	26-	22.0
Forearm	17+	14.0	3	1.4	3	1.4	0-	0.0	3	1.5	1	0.8
One-hand	-	-	-	-	-	-	-	-	-	-	-	-
Other technique	1+	0.8	-	-	-	-	-	-	-	-	-	-

Note: + o - statistical signification of *p*<.05 (chi square test). + o - relationship found (positive or negative).
* Data was calculated using the sequences of the rally as unit of analysis.

Table 8. Performance of setting according to the efficiency of prior reception/floor defense and levels of competition (women's indoor volleyball).

Setting performance	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Reception that can´t allow attack												
Error	13	9.0	5	4.5	1[-]	1.4	7	15.9	5	16.7	2	16.7
No attack	129	89.0	104	94.5	71	97.3	37	84.1	22	73.3	8	66.7
Limit attack	3	2.1	1	0.9	1	1.4	-	-	3[+]	10.0	2[+]	16.7
All attacks allowed	-	-	-	-	-	-	-	-	-	-	-	-
Reception that allows limited options of attack												
Error	17[+]	3.1	8	1.5	7	1.3	9	1.5	3	0.5	5	0.9
No attack	16	2.9	20[+]	3.7	4[-]	0.7	7	1.2	8	1.5	7	1.3
Limit attack	503[+]	90.5	478[+]	88.5	451	81.6	420	70.1	396	72.0	229[-]	43.4
All attacks allowed	20[-]	3.6	34[-]	6.3	91[-]	16.5	163[+]	27.2	143	26.0	287[+]	54.4
Reception that allows all attacking options												
Error	1	1.5	1	0.7	2	1.1	1	0.3	2	0.5	-	-
No attack	3[+]	4.5	4[+]	2.8	1	0.6	1	0.3	2	0.5	1	0.3
Limit attack	47[+]	71.2	87[+]	60.0	62[+]	34.6	78	22.6	55[-]	13.2	33[-]	10.0
All attacks allowed	15[-]	22.7	53[-]	36.6	114	63.7	265	76.8	358[+]	85.9	295[+]	89.7
Floor defense that can´t allow attack												
Error	15	12.8	23	17.0	17	14.9	9	8.7	14	20.0	6	12.8
No attack	100	85.5	108	80.0	95	83.3	93	90.3	54	77.1	41	87.2
Limit attack	2	1.7	4	3.0	2	1.8	1	1.0	2	2.9	-	-
All attacks allowed	-	-	-	-	-	-	-	-	-	-	-	-
Floor defense that allows limited options of attack												
Error	25	3.9	16	2.7	23	3.6	22	3.1	10	1.6	11	2.1
No attack	23	3.5	20	3.4	14	2.2	14	2.0	18	2.9	16	3.1
Limit attack	565[+]	87.2	489	84.0	507	78.5	514	72.6	494	79.4	304[-]	58.5
All attacks allowed	35[-]	5.4	57[-]	9.8	102	15.8	158[+]	22.3	100	16.1	189[+]	36.3
Floor defense that allows all attacking options												
Error	3	2.5	5	2.4	5	2.3	1	0.4	2	1.0	2	1.7
No attack	2	1.7	1	0.5	2	0.9	-	-	3	1.5	1	0.8
Limit attack	86[+]	71.1	129[+]	61.7	87	39.4	52[-]	22.6	52[-]	25.2	9[-]	7.6
All attacks allowed	30[-]	24.8	74[-]	35.4	127	57.5	177[+]	77.0	149[+]	72.3	106[+]	89.8

Note: [+] o [−] statistical signification of $p<.05$ (chi square test). [+] o [−] relationship found (positive or negative).
* Data was calculated using the sequences of the rally as unit of analysis.

This way, considering all the setting techniques, the efficacy increased as the age group and the level of competition increased. The results confirmed the need of practice and maturity to realize the setting (García-Alcaraz et al., 2014; Grgantov et al., 2006; Malina et al., 2004; Stamm et al., 2003), and provided reference values of the setters' evolution through their long-term development. International level setters, World Championship, presented a significantly higher efficacy with all setting techniques. These results could be considered as normal as the best-ranked teams have the best players, which make the previous actions send the ball in better conditions (Afonso et al., 2009; Bergeles et al., 2009; Inkinen et al., 2013; González-Silva et al., 2016; Palao et al., 2006).

Regarding the influence of the game phase in the setting pass, senior setters performed better in the side-out phase, which allow better attack conditions (Alexandros & Athanasios, 2017; González-Silva et al., 2016; João et al., 2007; Marcelino et al, 2014; João et al., 2010; Palao et al., 2006; Rocha et al., 2020; Silva et al., 2014a; Zetou et al., 2007). In the counter-attack phase, the same relationship between category and setting efficacy was not found. These results may be caused due to the relationship between defense efficacy and setter level do not allow to build the offense in optimal conditions. This could be due to the lower level of the young setters or the imbalance between attack and defense at senior level. In early stages, although the efficiency of floor defense is higher than in high levels (García-Alcaraz et al., 2013), it does not appear to compensate the lack of experience and technical skill of young setters. In senior levels, setters were not able to compensate the disadvantage of the floor-defense against the opponent's attack when they try to neutralize it (Castro & Mesquita, 2010; Marcelino & Mesquita, 2006; Silva et al., 2016). No significant differences in setting efficacy were found for the use of different setting techniques in the different game phases. The reason may be related to the decision-making skills of the setters to select which technique was more appropriate considering the performance of the previous action.

Regarding the setting depth from the net, there is higher efficacy in so far as the level increases. This tendency is higher when the ball is passed closer to the net (0 to 1.5m). However, when the set is executed farther from the net, these differences are smaller. The results show that the abilities of the setters evolve during their development, as does the difficulty of making a pass that creates an advantage over the opponent (Selinger & Ackermann-Blount, 1985). Regarding the zone of the net from which the set was executed, senior setters had more efficacy from all over the net than younger setters. These results could be to the accumulation of training and competitive experience needed to solve the different situations of the game (Afonso et al., 2008; Castro & Mesquita, 2010; Garcia-Alcaraz et al., 2017; Matias & Greco, 2011; Palao & Ahrabi-Fard, 2014).

Regarding the influence of the previous pass on the setting, in side-out and counterattack, the jump set occurred significantly more in the matches of higher levels independently of the efficacy of the previous actions (reception and floor-defense). The occurrence of the standing set was higher in early levels of competition with all types of performances of the previous pass (reception and floor-defense). These results concur with previous studies that have analysed the evolution of setting at different levels (Palao & Echeverría, 2008). The use of the jump-set requires an effective previous pass and an effective setter as well. Therefore, when setter and receptors/defensors increase their technical skills and experience, setters increase the use of the jump-set in all game phases. In early developmental stages levels (U-14 and U-16), although the previous pass was effective, the development of the setter does not allow the use of the jump set. The realisation of this technique requires experience, maturity, and technical skill of all the setters and the rest of players involved in the offense (Afonso et al., 2009; Bergeles et al., 2009; García-Alcaraz et al., 2014; Grgantov et al., 2006; Inkinen et al., 2013; Garcia-Alcaraz et al., 2017; Malina et al., 2004; Palao et al., 2006; Palao & Ahrabi-Fard, 2014; Stamm et al., 2003).

Practical applications

The results provided information about the evolution of a setting performance profile related to the way of execution in women's volleyball, from U-14 to senior international

levels. As the competition level increased, as does the setting performance and the usage of the jump-set technique. In all categories studied, the efficacy of the previous actions (serve-reception and floor-defense) set out the conditions of setting pass, although this influence decreases as the competition level increases. The setting efficiency did not change in different zones for the different levels. The paper provides reference values that could help coaches to analyse and evaluate this game action in their players and to develop training plans adapted to each stage of the development. Future studies should study the evolution of the setting with tactical aspects of the game (e.g., team system), physical condition (e.g., fatigue or jump ability), or psychological aspects (e.g., momentum). If possible, future studies should study the evolution of the players over a period of time (longitudinal study).

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