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EVOLUTION OF FLOOR DEFENSE EFFICACY AND EXECUTION IN WOMEN'S VOLLEYBALL FROM NATIONAL U-14 TO SENIOR INTERNATIONAL

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ABSTRACT

The study aimed to determine the technical performance profile of floor defense regarding execution and efficacy from national U-14 to senior international competitions. The sample of the study was composed of a total of 7,818 game phases from 48 matches in the following divisions: under-14, under-16, under-18, 2nd national senior division, 1st national senior division, and international senior division (World Championship). The study's variables were: "*age group and level of competition*", the technique used in floor defense, the zone where the defense was executed, attack tempo, and floor defense efficacy. The results indicate that the efficacy of the forearm defense and overhead defense increased up to U-18 category and decreased in senior categories. As the age group and level of competition increases, the efficacy of the different techniques of floor defense and zone defense changed. The attack tempo influenced the efficacy of the floor defense. The study provides data may help to establish the technical and tactical floor defense profiles in women's volleyball and to understand how this action changes throughout the developmental stages of the female volleyball players.

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

EVOLUCIÓN DE LA EFICACIA Y FORMA DE EJECUCIÓN DE LA DEFENSA EN CAMPO, EN VOLEIBOL FEMENINO DESDE CATEGORÍA INFANTIL HASTA SENIOR INTERNACIONAL

RESUMEN

El estudio trató de determinar el perfil de rendimiento técnico de la defensa en campo en función de la ejecución y eficacia en competición desde la categoría infantil hasta senior internacional en voleibol femenino. La muestra de estudio estuvo compuesta por un total de 7.818 fases de juego en 48 partidos repartidos en las siguientes categorías de competición: infantil, cadete, juvenil, 2º división nacional (liga FEV), 1º división nacional (Superliga) y senior internacional (Campeonato del mundo de selecciones). Las variables de estudio fueron: edad y nivel de competición, técnica de ejecución, zona de ejecución, tiempo del ataque defendido y eficacia de la defensa. Los resultados indican que la eficacia del pase de antebrazos y de dedos se incrementa con la edad hasta llegar a categoría juvenil y desciende en las categorías senior. Conforme la edad y nivel de competición se incrementa, la eficacia de las diferentes técnicas de ejecución y la zona donde se realizan cambia. El tiempo de ataque afecta a la eficacia de la defensa en campo. El estudio proporciona datos que pueden ayudar a establecer un perfil de rendimiento técnico-táctico de la defensa en campo, en voleibol femenino y a comprender cómo cambia esta acción de juego a lo largo de todas las etapas de desarrollo competitivo de las jugadoras de voleibol.

Palabras clave: deportes de equipo, rendimiento deportivo, análisis de juego, etapas de formación

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INTRODUCTION

In volleyball, floor defense is part of the actions done by teams to neutralize the opponent's offense (Selinger & Ackermann-Blount, 1985). It is the second action of the counterattack after the block. In elite levels of competition, floor defense is the action with the lowest efficacy, due to the greater superiority of attacking actions (Castro & Mesquita, 2010; Marcelino & Mesquita, 2006). It is not a skill which has a statistical correlation with winning (Durkovic, Marelic & Resetar, 2009), but it is necessary to have the chances of doing the counterattack (Monteiro, Mesquita & Marcelino, 2009). In developmental levels of competition, floor defense had higher efficiency than in senior levels, due to the lower efficacy of the opponent attack (García-Alcaraz, Palao & Ortega, 2013a). Winning teams in youth competition levels had higher values than losers in floor defense (Claver, Jiménez, Gil, Moreno & Moreno, 2013). Some of the key aspects to affect the floor defense are: a) speed of previous attack (Palao, Santos & Ureña, 2004); b) restrictions created by the opponent to build the attack (Laios & Kountouris, 2005); c) a ready posture to respond quickly (Amasay, 2008; Selinger & Ackermann-Blount, 1985); and d) experience and decision making of players (Araujo, Afonso & Mesquita, 2011). Through the development of the players, the maturity, training, and experience of the players change through the different stage of their development (from young ages to elite level). This affects the relationship between the spike and the floor defense and could affect the efficacy and way of execution of the floor defense.

Throughout the training process, floor defense needs to neutralize faster and more unpredictable spikes from more variety of attack systems (Katsikadelli, 1995; Marcelino, Afonso, Moreas & Mesquita, 2014; Palao, Santos, & Ureña, 2005). Although theoretically, the skills of the players to perform the floor defense increases through their development, the spike skill also increases creating an imbalance between both actions (Eom & Schutz, 1992; Palao, Santos, & Ureña, 2006). Previous studies did not find differences in the floor defense efficacy between matches of the senior World championship and Junior European Championship (U-18) (Inkinen, Häyrinen, & Linnamo, 2013). However, other studies found differences in the set and attack related to the way of execution, efficacy, and attack tempo between 1st Spanish senior national division, and senior international women matches (Palao & Echeverria, 2008). In theory, the acceleration in the offense and in the attack speed, because of maturity, training and experience (Grgantov, Katic & Jankovic, 2006; Lidor & Ziv, 2010a; Stamm et al., 2003; Stamm et al., 2004), should increase the actions done by players in no ideal conditions. These would involve changes in the technique and defense floor efficacy, due to the actions are done per players in the limits of the defensive spectrum (Selinger & Ackermann-Blount, 1985). If the player cannot intercept the ball with their body, the efficacy of the defense

decreases, and players need to use a dive or other techniques to try neutralizing the ball.

Floor defense tries to neutralize the opponent's attack. Most of the available information from floor defense is from the high-level competitions (e.g., Palao, Manzanares, & Ortega, 2009). The reduced information from early stages does not allow having an objective perspective of the development of the floor defense through the long-term development of the players. Reference values are needed to analyze object the evolution of the players according to their level and age group. Information about the effectiveness of floor defense, zones, and technique in the different stages of development could help coaches and research to guide the training, modify game rules, or establish specific goals. The study aimed to assess the technical profile of performance in floor defense from national U-14 to international senior in women's volleyball.

METHOD

Participants

The sample included 7,818 sequences played in 187 sets, corresponding to 48 volleyball matches (eight matches for each "age group and level of competition": U-14, U-16, U-18, 2nd national division, 1st national division, and international level). The matches were played by top 12 teams of the national competitions (Spanish national Club Championship, and second and first senior league) and senior international competition (World Championship) during season 2005-2006. The matches selected were the quarterfinals, semifinals, and finals. For the 2nd senior division matches from the promotion phase were analyzed. For the 1st national division, matches from the national cup were analyzed. In these competitions, due to there was no consolation final match, a match between the first four teams in these competitions were analyzed during the regular season (1nd and 2nd senior division). Table 1 describes the sample distribution. 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 volleyball).

Sample	U-14	U-16	U-18	2nd national	1st national	International	Total
Matches	8	8	8	8	8	8	48
Sets	29	35	32	27	31	33	187
Floor defenses	1347	1393	1379	1459	1274	966	7818

Design

The design of the study was a descriptive punctual, nomothetic, multidimensional, inter- and intra-group correlational (Anguera, Blanco & Losada, 2001). The sample was divided into six categories according to their "*age group and level of competition*": national U-14, national U-16, national U-18, senior 2nd national division, senior 1st national division, and senior international level. The efficacy and execution variables 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), floor defense efficacy (on scale from 0 to 3), floor defense zone (the court was divided into six equal zones), opponent attack tempo (first tempo, second tempo, third tempo, second contact attack, and attack at first contact), and floor defense technique (forearm, overhead, dive, and others techniques).

Floor defense efficacy was evaluated in relation to the success of the action and the options it gave to the team to build their counter-attack. The following four levels of efficacy were differentiated: error, no attack options, limited attack options, and maximum attack options (Coleman, Neville, & Gordon, 1969). For the category floor defense, an efficacy coefficient (sum of attempts per category multiplied by the value of the level and divided by total attempts (0-3)), a point-to-error ratio, and an efficiency value (perfect actions minus errors) were calculated. The attack tempo was established using the coordination between the spiker and the setter: spiker jumps when the set was done (first tempo), spiker executes the last step of the approach when the set was done (second tempo), and the spiker has not started the approach when the set was done (third tempo).

Procedure and equipment

The variables registered are part of the observation instrument (Observation Instrument of Techniques and Efficacy in Volleyball) that was designed and validated by Palao, Manzanares, and Ortega (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). The lowest inter-observer reliability was 0.82 and the lowest 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, the Chi-square test was used to study the differences in each category, and the Mann-Whitney U was used to analyze the differences between categories. The analyses were done with the SPSS 21 software. The level of significance was established at $p<.05$.

RESULTS

In floor defense technique (Table 2), the forearm technique increased its efficacy from U-14 to U-18 age groups and then decreased from 2nd national senior division to senior international category. The percentage of error significantly increased from U-18 level to senior international category. The overhand technique had a coefficient of efficacy significantly lower in U-14 and U-16 and higher in the 1st national senior division and senior international category. In the free-ball defenses, the coefficient of efficacy and the efficacy were significantly lower in U-14 and higher in senior categories. Regarding the dives, the coefficient of efficacy was significantly lower in U-14 and higher in senior categories. The percentage of error was significantly higher in U-14 and U-16 and lower in senior categories.

TABLE 2
Efficacy of floor defense technique according to levels of competition (women volleyball).

Technique	U-14		U-16		U-18		2nd national		1st national		International	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Forearm												
Coefficient	1.61^{cd}	0.08	1.77^{cd}	0.03	2.02^{abef}	0.27	1.88^{abef}	0.04	1.70^{cd}	0.20	1.67^{cd}	0.13
Efficacy (%)	7.95^{bcd}	1.89	17.45^{acf}	1.66	27.5^{abef}	12.64	19.7^{af}	2.66	15.08^{c}	6.57	10.66^{bcd}	3.38
Error (%)	15.45^{c}	2.39	14.27^{c}	2.87	7.58^{abef}	4.96	11.18^{f}	3.49	17.72^{c}	8.21	17.86^{cd}	5.81
Efficiency	-7.5^{bcd}	4.03	3.18^{cdf}	2.75	19.92^{abdef}	16.91	8.52^{abcf}	3.05	-2.64^{c}	14.20	-7.2^{bcd}	8.70
Ratio	1:0.22^{cd}	2.91	1:10.31^{cdf}	1.76	1:23.71^{abdef}	14.72	1:14.11^{abcf}	2.27	1:6.22^{c}	10.27	1:1.73^{bcd}	5.93
Occurrence	824^{+}		893^{+}		803^{+}		762^{-}		648^{-}		483-	
Frequency	54.3%		55.4%		52.2%		44.1%		40.0%		38.3%	
Underhand												
Coefficient	1.74^{ef}	0.09	1.72^{ef}	0.11	1.69	0.08	1.86	0.14	1.91^{ab}	0.1	1.97^{ab}	0.18
Efficacy (%)	11.82	6.89	17.75	4.96	11.25^{d}	2.96	21.32^{c}	8.96	12.44	8.13	15.22	7.69
Error (%)	13.85	4.14	15.37	4.84	18.10	7.12	13.34	6.07	7.38	6.37	8.25	7.72
Efficiency	-2.02	6.44	2.37	6.60	-6.95^{f}	5.86	7.98	12.33	5.06^{c}	7.26	0.92	13.26
Ratio	1:4.9	6.34	1:10.06	5.31	1:2.20^{d}	2.98	1:14.65^{c}	10.34	1:8.75	7.02	1:11.1	10.13
Occurrence	178		164		153		186		167		107^{-}	
Frequency	11.7%		10.2%		9.9%		10.8%		10.3%		8.5%	
Free-ball												
Coefficient	1.96^{df}	0.15	2.95	0.1	2.24	0.20	2.93^{a}	0.08	2.89	0.11	2.83^{a}	0.20
Efficacy (%)	40.4^{bcdef}	13.23	95^{a}	10	81.17^{a}	18.69	92.72^{a}	8.46	93.32^{a}	6.60	88.28^{a}	13.02
Error (%)	0	0	0	0	0	0	0	0	0	0	2.66	3.72
Efficiency	40.4^{f}	13.23	70	47.61	81.17	18.69	92.72	8.46	93.32	6.60	85.62^{a}	16.50
Ratio	1:40.4^{df}	13.23	1:95	10	1:81.17	18.69	1:92.72^{a}	8.46	1:93.32	6.60	1:86.95^{a}	14.75
Occurrence	75^{+}		34^{-}		49		56		65		50	
Frequency	4.9%		2.1%		3.2%		3.2%		4.0%		4.0%	
Dive												
Coefficient	0.77^{def}	0.04	0.98	0.10	0.67^{de}	0.40	1.10^{ac}	0.13	1.06^{ac}	0.13	1.11^{a}	0.22
Efficacy (%)	0.37^{d}	0.75	2.47	2.12	1.56	1.97	3.44^{d}	2.56	2.72	2.26	1.58	1.77
Error (%)	49.97^{def}	1.62	52.22^{df}	7.09	40.04	22.98	40.42^{ab}	3.83	39.94^{a}	5.98	35.52^{ab}	7.36
Efficiency	-49.6	1.54	-49.75	5.20	-38.48	22.33	-36.98	5.90	-37.22	7.73	-33.94	8.27
Ratio	1:-24.61	0.90	1:-23.64	1.72	1:-18.46	10.92	1:-16.77	4.13	1:-17.25	4.85	1:-16.18	4.71
Occurrence	213^{-}		215-		284		329		313		267^{+}	
Frequency	14%		13.3%		18.5%		19%		19.3%		21.2%	
Other technique												
Coefficient	1.00	0.22	0.93^{de}	0.18	1.04	0.27	1.08^{b}	0.21	1.32^{b}	0.27	0.86	0.52
Efficacy (%)	1.92	3.85	0	0	1.05	2.10	1.24	1.70	2.22	4.96	1.42	3.17
Error (%)	28.27	10.77	38.6	12.05	36.3	13.35	31.04	8.88	21.72	15.40	48.28	30.24
Efficiency	-26.35	14.03	-38.6	12.05	-35.25	14.64	-29.80	8.70	-19.5	17.91	-46.86	30.30
Ratio	1:-12.2	8.77	1:-19.3	6.02	1:-17.1	8.05	1:-14.28	4.42	1:-8.64	10.65	1:22.72	15.35
Occurrence	57^{-}		87		90		126^{+}		81		59	
Frequency	3.8%		5.4%		5.8%		7.3%		5.0%		4.7%	
No touch												
Occurrence	171^{-}		218^{-}		160^{-}		269		346+		295^{+}	
Frequency	11.3%		13.5%		10.4%		15.6%		21.4%		23.4%	

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).

Regarding the incidence on the game of the different floor defense techniques (Table 3), the forearm defenses had a significantly higher occurrence of actions that were not finished with an attack in U-14 category and a significantly lower occurrence in the senior international category. The forearm defenses that allowed all attacking options for the team had a significantly higher occurrence in U-18 and 2nd national senior division and lower in U-14 and senior international category. The free-ball defenses had a significantly lower occurrence of the performance that allowed all attack options in U-14 age group and higher in the rest of the levels. The dive defense had a significantly lower occurrence of errors in senior international level than the rest of levels. The efficacy of dive defense that allowed limited options of attacking was significantly higher in senior international level and lower in U-14 and U-16 categories.

TABLE 3
Performance of floor defense technique according to levels of competition (women volleyball).

Technique	U-14		U-16		U-18		2nd national		1st national		International	
	n	%	n	%	n	%	n	%	n	%	n	%
Forearm												
Error	126	15.3	126	14.1	80-	10.0	76-	10.0	97	15.0	80+	16.6
No attack	132+	16.0	105	11.8	81	10.1	72	9.4	70	10.8	39-	8.1
Limit attack	501	60.8	507	56.8	466	58.1	468	61.4	369	56.9	307	63.6
All attacks allowed	65-	7.9	155	17.4	175+	21.8	146+	19.2	112	17.3	57-	11.8
Underhand												
Error	24	13.5	25	15.2	23	15.0	26	14.0	15	9.0	8	7.5
No attack	16	9.0	24	14.6	26+	17.0	16	8.6	14	8.4	3-	2.8
Limit attack	117	65.7	87	53.0	88	57.5	108	58.1	112	67.5	80	74.8
All attacks allowed	21	11.8	28	17.1	16	10.5	36	19.4	25	15.1	16	15.0
Free-ball												
Error	-	-	-	-	-	-	-	-	-	-	2+	4.0
No attack	4	5.3	-	-	1	2.0	-	-	3	4.6	-	-
Limit attack	31+	41.3	1-	2.9	10	20.4	5	8.9	2-	3.1	7	14.0
All attacks allowed	40-	53.3	33	97.1	38	77.6	51	91.1	60	92.3	41	82.0
Dive												
Error	106	49.8	112	52.1	136	47.9	136	41.5	117	37.6	94-	35.3
No attack	51+	23.9	55+	25.6	47	16.5	45	13.7	54	17.4	41	15.4
Limit attack	55-	25.8	43-	20.0	95	33.5	138	42.1	130	41.8	126+	47.4
All attacks allowed	1	0.5	5	2.3	6	2.1	9	2.7	10	3.2	5	1.9
Other techniques												
Error	16	28.1	31	35.6	34	37.8	38	30.2	22	27.2	21	35.6
No attack	25+	43.9	28	32.2	23	25.6	38	30.2	18	22.2	11	18.6
Limit attack	15	26.3	28	32.2	32	35.6	48	38.1	39	48.1	26	44.1
All attacks allowed	1	1.8	-	-	1	1.1	2	1.6	2	2.5	1	1.7

Note: ⁺ o ⁻ statistical signification of p<.05 (chi square test). ⁺ o ⁻ relationship found (positive or negative).

In the efficacy of floor defense according to attacking tempo (Table 4), the defense against 1st tempo attacks had a higher coefficient of efficacy in U-18 and 1st national senior division. The defense against the attacks at the 1st touch of the play had a percentage of error significantly higher in the 1st national senior division and senior international level and lower in early training stages.

TABLE 4
Efficacy of floor defense according to timing attack and levels of competition (women volleyball).

Timing	U-14		U-16		U-18		2nd national		1st national		International	
attack	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Defense of 1st tempo attack												
Coefficient	-	-	-	-	0.45[e]	0.33	0.86	0.32	1.10c	0.50	0.8	0.43
Efficacy(%)	-	-	-	-	7.68	11.97	4.96	3.50	4.64	5.58	2.24	2.19
Error (%)	-	-	-	-	60.24	37.66	45.16	29.33	57.18[e]	6.81	74.52[f]	16.46
Efficiency	-	-	-	-	-52.56	40.06	-40.2	28.22	-52.54[e]	9.23	-72.28[f]	17.89
Ratio	-	-	-	-	1:-22.4	22.79	1:-17.6	13.76	1:-23.95[e]	6.82	1:35.02[f]	9.73
Defense of 2nd tempo de attack												
Coefficient	0.37[de]	0.48	0.87	0.83	0.63d	0.42	1.47[ac]	0.55	1.08	0.81	1.11[a]	0.18
Efficacy(%)	2.5	5	-	-	-	-	3.76	4.13	2.1	1.97	5.97[bc]	2.57
Error(%)	72.07	40.92	55	41.23	63.1	25.45	41.8	12.63	59	8.81	56.62	10.07
Efficiency	-69.57	45.73	-55	41.23	-63.1	25.45	-38.04	12.64	-56.9	8.74	-31.27	10.93
Ratio	1:-33.5	25.29	1:-27.5	20.61	1:-31.5	12.73	1:-17.14	6.97	1:-27.4	4.56	1:-22.34	6.04
Defense of 3rd tempo de attack												
Coefficient	1.14	0.55	1.08[c]	0.05	1.27b	0.09	1.31	0.57	1.12	0.14	1.44	0.88
Efficacy(%)	4.65[bcd]	1.02	6.75[ae]	0.54	7.87ae	2.57	14.48[ae]	15.19	7.27	2.23	3.9[bcd]	1.55
Error (%)	38.37	4.05	42.4	3.35	36.72	3.04	32.52	19.21	42.62	5.61	45.82	5.98
Efficiency	-26.98	4.88	-26.72	18.09	-28.85	5.55	-18.04	33.27	-35.35	6.25	-41.92	6.76
Ratio	1:-11.63	2.88	1:-14.45	1.47	1:-10.49	4.05	1:-1.78	24.01	1:-14.04	3.76	1:-19.01	3.89
Defense of attack at 2nd touch												
Coefficient	1.53	0.48	1.47	0.23	1.14	0.53	2.45	2.02	1.29	0.42	1.28	0.49
Efficacy(%)	9.2	9.36	1.4	2.8	5	11.18	7.5	11.18	13.78	20.86	3.34	7.47
Error (%)	22.05	20.04	27.52	10.45	22.5	25.62	40	37.91	31.82	19.91	24.44	25.03
Efficiency	-12.85	22.31	-26.12	11.70	-17.5	30.10	-32.5	42.94	-18.04	25.11	-21.1	21.65
Ratio	1:-1.82	13.87	1:-12.36	6.71	1:-6.25	18.75	1:-12.5	25	1:-2.13	20.83	1:-8.88	10.28
Defense of attack at 1st touch												
Coefficient	0.74[d]	0.21	1.10	0.22	0.56	0.66	1.26[d]	0.48	0.97	0.87	0.62	0.43
Efficacy(%)	-	-	6.7	7.77	5	12.5	12.86	21.66	10	22.36	-	-
Error (%)	53.75	20.22	38.42[ef]	4.07	52.65	32.99	40.36[e]	9.00	64.2[bd]	10.90	62.22[b]	22.71
Efficiency	-53.75	20.22	-31.72[f]	6.48	-46.4	35.90	-27.5	28.48	-54.2	31.20	-62.22[b]	22.71
Ratio	1:-26.9	10.11	1:-12.51[b]	6.86	1:20.07	21.22	1:-7.32	24.90	1:-22.1	26.59	1:-31.11[b]	11.36

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).

In the efficacy of floor defense according to the zone it was made (Table 5), the forearm technique had a significantly lower coefficient of efficacy in U-14 than in senior levels in zones 3 and 5. The overhand technique had a significantly higher coefficient of efficacy in senior international level than U-14

category in zone 4. The defense of free-balls had a significantly higher coefficient of efficacy in the 1st national senior division and senior international level than in U-14 categories in zone 6. The dive defense had a significantly higher coefficient of efficacy in senior levels than U-14, U-16, and U-18 in zone 3.

TABLE 5
Efficacy of floor defense technique according to performing area and levels of competition (women volleyball).

Technique	U-14		U-16		U-18		2nd national		1st national		International	
	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef	n	Coef
Forearm												
Zone 1	146	1.51	175	1.59	158	1.75	141	1.78[f]	155	1.65	111[+]	1.57[d]
Zone 2	37[-]	1.70	48	1.83	61	1.98	55	1.90	41	1.95	42[+]	1.92
Zone 3	67	1.67[df]	97	1.76[d]	71	1.97	87	2[ab]	73	1.96	36	2[a]
Zone 4	39[-]	1.64	68	1.90	83[+]	1.88	76[+]	1.95	45	1.89	35	1.88
Zone 5	202	1.42[bcf]	181	1.69[a]	150[-]	1.97[a]	151	1.73	155	1.67	115	1.58[a]
Zone 6	333[+]	1.75	324	1.89[b]	279	1.97	210	2.04[d]	179[-]	1.79	103[-]	1.74
Underhand												
Zone 1	27	1.85	31	1.45	32	1.47	45	1.81	32	1.91	17	1.76
Zone 2	11	1.91	16	1.56[c]	26[+]	2.08[b]	15	1.75	20	2.05	11	2.27
Zone 3	23	1.96	31	1.64	21	1.90	28	2	24	1.83	15	2
Zone 4	15	1.6f	19	2.05	10	1.6	12	1.78	15	1.73	17[+]	2.11[a]
Zone 5	36[+]	1.39	30	1.6	28	1.28	27	1.48	37	1.76	20	1.6
Zone 6	66	1.86	37	2	36	1.58	50	1.96	38	2	27	2.15
Free-ball												
Zone 1	10	2.5	4	3	9	2.89	6	3	16	2.87	7	2.86
Zone 2	1	3	0	-	1	2	2	2.5	2	3	4[+]	2.75
Zone 3	12	2.67	4	2.75	5	2.8	11	2.92	10	3	6	2.83
Zone 4	2	3	1	3	2	2.5	3	2.67	4	3	6[+]	2.33
Zone 5	24[+]	2.43	5	3	6	2.67	6	2.83	9	2.55	8	2.62
Zone 6	43	2.39[bdef]	20	3[a]	26	2.77	21	2.96[a]	24	2.92[a]	19	2.84[a]
Dive												
Zone 1	30	0.83	10-	0.76	43	0.86	46	0.90	63	1.11	39[+]	1
Zone 2	14	0.79[f]	30+	0.7[ef]	32	0.81	47[+]	1	20[-]	1.32[b]	24	1.33[ab]
Zone 3	59[+]	0.59[def]	51	0.63[def]	67	0.85[def]	67	1.22[abc]	42[-]	1.07[abc]	35[-]	1.23[abc]
Zone 4	14	0.64[e]	16	0.69	27	0.85	22	0.96	38	1.37[a]	32	1.16
Zone 5	25	0.72[ef]	20	0.5[ef]	33	0.82	56	0.82	52	1.02[ab]	50	1.28[ab]
Zone 6	71	0.93	64	0.87[e]	82	1.04	65[-]	1.28[e]	96	1[d]	6	1.08[b]
Other techniques												
Zone 1	7	0.83	11	0.76	15	0.86	18	0.90	13	1.11	9	1
Zone 2	11	0.78[cd]	20	0.7	20	0.81[a]	25	1[a]	11	1.31	11	1.33
Zone 3	18	0.59	16	0.63[e]	16	0.85	26	1.22	24	1.07[b]	10	1.23
Zone 4	9	0.64	14	0.69	16	0.85	17	0.96	8	1.37	12	1.16
Zone 5	31[+]	0.72	13	0.5	11	0.82	18	0.82	6[-]	1.02	9	1.28
Zone 6	7	0.93	13	0.87	12	1.03	8	1.28	17[+]	1	8	1.08

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).

DISCUSSION

This study shows the evolution of the floor defense performance in women's volleyball from U-14 to senior international competition. The reduction of the ball contact for the defenders through the different stage of development of the players (defenders do not touch two out of ten attacks) is probably caused by an increase of the attack power (Costa, Afonso, Brant, & Mesquita, 2012; García-Alcaraz et al., 2015). The forearm technique and the dive were the technique more used at all levels. When the "*age group and level of competition*" increased, the floor defense is done in less stable and predictable situations. Players must adapt to the conditions created by the attack. This tendency is shown by the reduction of the use of the forearm as increased the level of the competition (54% to 38%), and the increase in the use of the dive as increased the age group and level of competition (14% to 21%). The rest of the techniques or situations studied presented a low level of use (<10%). This information can be used a guide to establish the proportions of the different techniques that the players should work to develop their floor defense skills.

Regarding the performance, the forearm technique performance increased from U-14 to U-18 categories. However, in senior level, the forearm performance decreased from the 2nd national senior division to the senior international competition. The reason may be either in an improvement of the player's technique or a lower influence of attacking actions in these early levels of competition (Costa et al., 2012) compared to senior levels (García-Alcaraz et al., 2015). The lower efficiency in U-14 level was found in previous studies (Ureña, Morales-Rojas, León & González, 2014). The same significant improvements were found in early levels of male volleyball (García-Alcaraz et al., 2013b). At these formative levels, floor defense is a more influential action in the final score than in higher levels (Costa et al., 2012). This study shows a trend of a reduction efficiency as the level of senior competitions increases. In high levels, the higher power and variety of hitting options difficult the actions of the defender (Palao et al., 2005), making floor defense the action with the lowest efficient of all volleyball skills (Marcelino & Mesquita, 2006).

Different trends were found in the rest of the floor defense techniques. The overhand technique showed higher efficiency in senior levels than early stages. This technique is used to neutralize a less powerful attack, which may allow a higher efficacy on behalf of prior conditions of playing (Palao et al., 2009). The situations of "free-ball" (no opponent attack) were the floor defense that involved a higher efficacy and allowed senior teams to build a more efficient counterattack (Selinger & Ackermann-Blount, 1985). Each situation of the game had a different and distinct level of efficacy. This aspect should be considered by coaches to analyze the actions of their players in practice and competition

properly. For example, reference values that could be used in practice by coaches will be the following: a) for the forearm, seven defenses that allow the attack out of ten ball contacts (only one that allows all attack actions), b) for the free ball defense, eight defenses that allow all attack option out of ten defenses, and c) for other techniques, four defenses that allow attack out of ten defenses. These values are stable and similar for all categories studied, except for the techniques done in extreme conditions in which the criteria should be lower (e.g., dive and other techniques).

The timing of attack influences the efficiency of floor defense. Slower attack allowed higher efficacy in floor defense, due to players have more time to intercept and neutralize the ball (Selinger & Ackermann-Blount, 1985). This is confirmed by the higher percentage of errors in defense against spikes at the first touch in the game sequence. In this situation, the advantage belongs to the hitter because of the shorter time allows preparing their defense (McGown, Fronske & Moser, 2001). The defense of quick attacks (1st and 2nd tempo) improved from the early levels of competition to the senior levels, except senior international level. The higher presence of quick-attack tempos in high levels (Palao et al., 2005: Palao & Echeverria, 2008) allows its development both in training and competition. Therefore, players at these levels gain greater experience and control. However, against slower spikes, the efficiency of floor defense increases from the early stages to 2nd national senior division and then decreases until the highest level. At the highest level, senior international competition, there are stronger and more powerful attack (Costa et al., 2014: Inkinen, Häyrinen & Linnamo, 2013) that have a higher correlation with success in volleyball (Grgantov, Katic & Jankovic, 2006; Miskin, Fellingham, & Florence, 2010).

Regarding the zone where the defense is made, for all techniques and situation studies, the zones closed to the net presented a higher efficacy. These results could be considered normal, due to the ball had a more parabolic and slower trajectory to overcome the net and the block than the ball directed to the end of the court. The performance of zone 5 increased from U-14 to the rest of the categories. That zone is usually taken by the libero, a player who influences the performance in defense in high levels of competition (Mesquita, Manso, & Palao, 2007). This specialist player may also influence the higher efficiency of "free-ball" defense in zone 6, due to this way she allows other players to incorporate to counter-attack.

CONCLUSIONS

Data provided by this study show the evolution of the occurrence, the way of execution, area, and efficiency of the floor defense from U-14 to senior international competitions of women's volleyball. The most used defensive

technique in all analyzed levels was the forearm. The results show how training and experience change the balance between offense and defense, in favor of the attack. This trend was not found with other techniques such as overhand pass or defense against the 1st tempo attacks, where the efficiency rises according to the age group. The efficacy of the different techniques varies over the age groups and competition levels studied, which involve the need for specific reference values to consider for each technique and players' stage of development. The information provided could help coaches to analyze and evaluate this game action in their players and develop a working plan adapted to the specific age groups and level of competition of the players, both in attack and counterattack. It is necessary to consider the data of the study did not follow the evolution of the sample players through the time; analyze some age groups and level of competition; and part of the sample is composed of players from one country. However, the data provide objective values of the manner of execution of the floor defense through the development stages of female volleyball players. Futures studies should be done to confirm the findings of this research. Future works should also analyze how the offense actions influence the floor defense, the contribution of the different players' role, or how the defense system influence on floor defense.

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