

EFFICACY AND MANNER OF EXECUTION OF THE SERVE IN TOP-LEVEL WOMEN'S BEACH VOLLEYBALL PLAYERS

EFICÁCIA E MANEIRA DE EXECUÇÃO DO SERVIÇO EM JOGADORAS DE VOLEIBOL DE PRAIA DE ALTO NÍVEL

Ana Belén López-Martínez¹, José Manuel Palao², Enrique Ortega³ and Antonio García-de-Alcaraz^{4,5}

¹Faculty of Sport Science. University of Catholic of San Antonio Murcia, Guadalupe-Murcia, Spain.

²University of Wisconsin Parkside, USA.

³Faculty of Sport Sciences. University of Murcia, Spain.

⁴Faculty of Educational Sciences. University of Almería, Spain.

⁵LFE Research Group. Universidad Politécnica de Madrid, Spain.

RESUMO

O estudo da forma de execução (técnica e aspectos espaciais) pode fornecer informações úteis para compreender a dinâmica do jogo no vôlei de praia e obter valores de referência para a análise do jogo e o estabelecimento de metas de treinamento. O objetivo do estudo foi determinar a influência da forma de execução no desempenho de saque e rali em jogadoras de vôlei de praia de alto nível. Um total de 3.009 saques de 44 jogadoras de alto nível foram analisados. As variáveis estudadas foram: técnica de saque, zona de saque, destino do saque, desempenho de saque e desempenho de rali. Um desenho observacional pontual, nomotético, multidimensional e intragrupo foi utilizado. Foi realizada uma análise descritiva e inferencial dos dados (Teste Qui-Quadrado) utilizando o software SPSS v.21.0. O nível de significância foi estabelecido em $p < 0,05$. A maneira de execução influencia o desempenho do saque. O saque flutuante de salto foi o mais usado. O destino mais efetivo foi a zona entre jogadoras, provavelmente devido ao deslocamento das jogadoras e a interferência entre elas. Não foi encontrada associação entre a técnica de saque e o desempenho de rali. Esses achados mostraram possíveis associações entre a maneira de executar o saque com as ações seguintes realizadas pelas jogadoras e as estratégias das jogadoras para controlar sua carga física. Esses valores podem ser úteis para orientar o treinamento de jogadoras ou avaliar jogadoras em competição de vôlei de praia.

Palavras-chave: Time esportivo. Performance. Análise de desempenho. Técnica.

ABSTRACT

The study of the manner of execution (technique, and spatial aspects) can provide useful information to understand the game dynamics in beach volleyball and to obtain references values for the analysis of the game and the establishment of training goals. The aim of the study was to determine the influence of the manner of execution on serve and rally performance in elite women's beach volleyball players. A total of 3,009 serves from 44 women's players were analyzed. The variables studied were: serve technique, serve zone, serve destination, serve performance, and rally performance. An observational punctual, nomothetic, multidimensional, and intragroup design was used. A descriptive and inferential analysis of the data (Chi-Square Test) was done using SPSS v.21.0 software. The level of significance was set at $p < .05$. The manner of execution influences the serve performance. The jump float serve was the most used. The most effective destination was the zone between players, probability due to the players' displacement and interference between them. An absence of association between serve technique and rally performance was found. These findings showed possible connections between the way of executing the serve with the following actions done by the players and the players' strategies to control their physical load. These values may be useful to guide to players training, or to evaluate players in competition.

Keywords: Team Sport. Performance. Match Analysis. Technique.

Introduction

The use of statistical analysis in volleyball and beach volleyball is common to analyze the actions of players in practice and competition¹. The use of different metrics, type of analysis, game actions and phases can provide different perspectives of the game that helps coaches to understand the insights of the game². Statistical analysis allows obtaining objective

information to plan the coaching process and to prepare competitions. In beach volleyball, all the plays start with the serve. This action influences the rest of the rally. The manner of execution of the serve is conditioning by the individual technique of the player, weather conditions (e.g., wind or sun), the opponents' team performance, or game requirements³. The study of the manner of execution (technique, and spatial aspects) can provide useful information to understand the game dynamics in beach volleyball and to obtain references values for the analysis of the game and the establishment of training goals.

The purpose of the serve is to get a direct point or difficult the actions of the opponent to build their offense. There are different types of serve with different purposes. The jump power serves try to difficult the opponent action or get point through the power and speed. The jump float serves try to create an unpredictable trajectory of the ball. The standing serves try to difficult the opponent's reception with greater accuracy or unpredictable trajectory⁴. The differences in net height, anthropometry, and physical capacities between male and female beach volleyball players⁵ made that the serve execution presents differences between genders. The technique most used in females is the standing serve⁶⁻⁸ and in males is the jump power serve⁸⁻¹⁰. The jump power serve is the technique that involves more points and more errors^{7-9,11}. Therefore, the balance between point and errors made this serve less efficient⁷. Regarding the way of execution, most of the serves are realized near the serving line, but the serve zone changes for each type of serve. The standing serve is mostly realized in the right and central zone, whereas the jump power serve is frequently realized in the central and left zone⁷. The most effective destination was the trajectory in which the serve was directed to the zone between both receivers⁷.

Most of the previous studies have studied the efficacy of the serve^{4,6-11}, but not the relation that the serve and its way of execution have on the outcome of the rally. The analysis of this relationship could provide information about how these actions contribute to the game. This information will increase the understanding of the game dynamics, and the contribution of the serve on the game. This also could be useful for coaches to establish training goals and prepare competition. The aim of this study was to analyze the influence of the serve technique and its manner of execution on serve efficacy and rally performance in elite women's beach volleyball players.

Methods

Participants

A total of 3,009 serves from 44 women's players (22 women's teams) in 71 sets were analyzed. The sample includes 82.6% of the serves executed in the 2008 Beijing Olympics Games

Procedures

The study followed the ethical principles from the declaration of Helsinki. An observational punctual, nomothetic, multidimensional, and intragroup design was used¹². The rally was the unit of analysis. The variables of the study were: serve technique (standing serve, jump float serve, and jump power serve), serve zone (area was divided into six equal zones), serve destination (the court was divided into ten equal zones) (Figure 1), serve performance (on scales 0 to 4), and rally performance (the serving team win, lose or play continuity after the serve). The serve performance was established in relation to the impact of the serves on the game and opponent team. Five categories were differentiated in relation to the success of the action and the options it gave to the opponent team to build their offense: error, not limit opponent attack, limit opponent attack, do not allow opponent attack and

point¹³. With the serve performance, the efficacy coefficient and the ratio point-error (number of points scored in terms of the mistakes performed) were calculated.

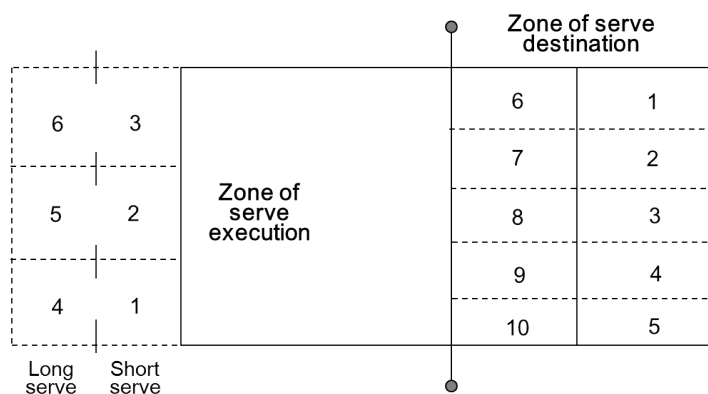


Figure 1. Zones of serve execution and court zones where the reception is carried out (adapted from Palao, Manzanares, & Ortega, 2015; Rule 7.4, FIVB, 2008)

The matches were recorded from international TV channels (NBC and Olympic Games International channel) and by coaches. The former used back and lateral filming angles, while the latter set the camera at the end (back) of the court. The variables registered are part of the validated Observational Instrument of Techniques and efficacy in beach volleyball¹⁴. A single observer did the observation. The observer had a Sports Science degree, was a beach volleyball athlete (more than ten years), was a beach volleyball coach (two years) and had previous experience doing statistical analysis in beach volleyball. The observer had a training process of five sessions of two hours, watching videos corresponding to the study's sample and debating each situation with a doubt. After training and observation process, an inter- and intra-reliability (Cohen's Kappa) was calculated for all variables. As a reference, another research was used. This observer had Ph.D. in Sports Science, more than 10 years of experience as a volleyball coach and doing statistical analysis, who observed the 25% of the sample analyzed. In all the variables the values were higher than .90 (inter-) and .98 (intra)^{15,16}.

Statistical analysis

A descriptive and inferential analysis of the data (Chi-Square Test) was done using SPSS v.21.0 software (SPSS Inc., Armonk, NY, USA). The set performance, rally outcome and the zone of the serve were compared to the manner of execution (serve technique) in order to analyze the association between these variables. The level of significance was set at $p < .05$. Moreover, the effect size was calculated in terms of *Crammer's V*, with values of 0.1, 0.3 and 0.5 to small, medium or large effects, respectively.

Results

Regarding the serve technique and their efficacy (Table 1), the jump float serves presented a higher occurrence (44.8%) than the standing serve (32.8%) and jump power serve (22.3%). The different types of serve presented similar efficacy (coefficient of 1.52-1.57 out of 4). The jump power serves presented more unbalance point to error ratio. A statistically significant association and a large effect was found between the serve performance and the serve technique ($p=.001$; $V=0.58$). The standing serve involved a significantly lower number

of errors and a significantly higher occurrence of serves than did not limit the opponent attack. The jump power serves involved a significantly higher number of errors and a significantly lower occurrence of serves than did not limit the opponent attack. The jump float serves involved a significantly lower number of errors.

Table 1. Type of serve and performance in women's beach volleyball

	Standing serve		Power jump serve		Floating jump serve		Total	
	n	%	n	%	n	%	n	%
Error	78 ⁻	7.90	120 ⁺	17.83	122 ⁻	9.04	320 ⁻	10.63
Max options	418 ⁺	42.35	205 ⁻	30.46	540	40.03	1,163 ⁺	38.65
Options	424	42.96	282	41.90	575	42.62	1,281	42.57
No options	8	0.81	12	1.78	19	1.41	39	1.30
Point	59	5.98	54	8.02	93	6.89	206	6.85
Occurrence	987	100	673	100	1,349	100	3,009	100
Coefficient	1.55		1.52		1.57		1.55	
Point-to-error ratio	1:1.32	1:2.22	1:1.31	1:1.55	1:1.32	1:2.22	1:1.31	1:1.55

Note. ⁺: positive association; ⁻: negative association

Source: Authors

Regarding the serve zone and the serve technique (Figure 2), the standing serve were most executed in zones near to the line (56%). The same tendency was found for the jump serves (>90%). A statistically significant association with a moderate effect was found between the serving area, serve technique, and serve efficacy ($p<.001$; $V=0.44$). The standing serves executed from zone 1 involved a significantly lower number of serves that allowed maximal attack options to the opponent and a significantly higher occurrence of points. The standing serves executed from zone 6 involved a significantly higher number of errors. The jump power serves executed from zone 1 involved a significantly lower number of errors. The jump float serves executed from far-zone 1 involved a significantly lower number of serves that allowed the maximal attack options.

Standing serve (n=987)			Power jump serve (n=673)			Floating jump serve (n=1,349)		
8.9%	14.9%	32.5%	21.0%	31.5%	46.5%	36.1%	31.4%	25.0%
1.57	1.45	1.66	1.42	1.50	1.58	1.56	1.52	1.61
1:0.8	1:2.6	1:0.9	1:2.9	1:2.8	1:1.6	1:1.4	1:1.4	1:1.1
11.9%	19.5%	12.2%	0.1%	0.7%	0.1%	2.4%	2.4%	2.7%
1.50	1.54	1.39	-	-	-	1.64	1.53	1.83
1:1.8	1:1.2	1:8.0	-	-	-	1:1.5	1:1	1:1

Figure 2. Occurrence (percentage), performance coefficient, and point-to-error ratio of the different types of serve in relation to the zone of serve execution

Note: Zone of execution with an occurrence lower than 1% was not include in the Figure

Source: Authors

Regarding the destination and the serve (Figure 3), most of the serves were directed to far away part of the court, independently the serve technique used (>87%). A statistically significant association with a low effect was found between destination, serve technique, and

serve efficacy ($p < .001$; $V = 0.29$). The standing serves directed to zone 2 and zone 4 involved a significantly higher number of serves that allowed maximal attack options to the opponent.

The standing serves directed to zone 3 and 5 involved a significantly lower number of serves that allowed maximal attack options to the opponent and a significantly higher number of serves that limit the opponent attack and serve points. The jump power serves directed to zone 1 involved a significantly higher number of serves that limit the opponent attack. The jump power serves directed to zone 2, and zone 4 involved a significantly higher number of serves that allowed maximal attack options to the opponent and a significantly lower number of serve points. The jump serves directed to zone 3 and 5 involved a significantly lower number of serves that allowed maximal attack options to the opponent and a significantly higher number of serves that limit the opponent attack and serve points. The jump serves directed to zone 6, 7 and 8 involved a significantly higher number of s serve points. The jump float serves directed to zone 1 involved a significantly higher number of serves that limit the opponent attack. The jump float serves directed to zone 2 and zone 4 involved a significantly higher number of serves that allowed maximal attack options to the opponent and a significantly lower number of serve points. The jump float serves directed to zone 3 involved a significantly lower number of serves that allowed maximal attack options to the opponent and a significantly higher number of serves that limit the opponent attack and serve points. The jump float serves directed to zone 5 and 8 involved a significantly higher number of s serve points.

Standing serve (n=907)					Power jump serve (n=553)					Floating jump serve (n=1,226)				
5.5%	23.4%	25.0%	28.9%	7.1%	9.0%	27.5%	28.8%	22.2%	6.3%	8.3%	22.8%	25.0%	24.6%	6.4%
1.80	1.51	2.00	1.45	1.95	2.10	1.46	2.13	1.44	2.49	1.92	1.49	1.92	1.50	1.94
1.2%	2.2%	2.8%	3.3%	0.7%	1.3%	2.4%	1.3%	0.7%	0.5%	1.8%	3.0%	3.3%	2.6%	2.2%
1.64	1.70	1.68	1.77	1.33	3.43	2.46	2.57	2.75	2.00	2.19	1.89	2.10	1.91	1.78

Figure 3. Occurrence (percentage) and performance coefficient of the different types of serve in relation to the destination zone in women's beach volleyball

Source: Authors

No statistically significant differences were found between the type of serve and the rally outcome (Table 2). Similar values of lost, continuity, and won were found between the use of the different serve techniques.

Table 2. Type of serve and rally performance in women's beach volleyball

	Standing serve		Power jump serve		Floating jump serve		Total	
	n	%	n	%	N	%	n	%
Lost	292	29.60	177	26.30	384	28.51	856	28.37
Continuity	511	51.72	363	53.94	736	54.51	1,613	53.46
Won	184	18.69	133	19.76	229	16.99	548	18.16
Occurrence	987	100	673	100	1,349	100	3,017	100

Source: Authors

Discussion

The aim of the study was to analyze the technique and manner of execution (zone of execution and destination zone) of serve, and its effect on serve performance and the rally performance, in top-level women's beach volleyball players. The different serve techniques had similar efficacy and impact on the rally performance. No differences were found in the efficacy of the different types of serves. Nevertheless, the jump float serves presented a higher frequency of use than the rest of the serves (44%). The causes behind its higher usage may be related to its significantly lower number of errors. The standing serves also involved a significantly lower number of errors but increased significantly the situation in which the serve limits the attack options of the opponent. These did not occur with the jump float serve.

The power jump serves presented the lower use, probably due to it is used increased significantly the errors although reduced significantly the situation in which the opponent builds their offense in good conditions. These findings differ from previous studies in which the standing serve was the most used^{7-9,11}. This could be related to the characteristics of the sample or an evolution in the players' tendencies. Previous studies analyzed national tournaments or event of the World Tour. More studies are needed to confirm this trend in the use of the different serve techniques. Other aspects could influence the criteria that player use to select which type of serve technique used. Studies in male beach volleyball players showed players tend to reduce the jumps to reduce the physical and fatigue during the game¹⁰. These tendencies could also occur in female beach volleyball, due to in their competition there is higher continuity than in male beach volleyball¹⁷. Future studies are needed to confirm this hypothesis.

In the analysis of the serving zone is possible to find different tendencies for each serve technique. Standing serve presented a higher used and efficacy from the right zone. However, the zone far away for the line was used a ~40% to execute the standing serve. The reason of these results could be related to the need of more space to create flotability and unpredictability in the serve^{4,18}. Little is known on how the reduction of the court size in beach volleyball have impacted on the ball flotability and reception of this type of serve. This option was used for players, although it increased the distance to cover by players to defense and their physical load. Jump power serve is execute closed to the serving line and from the right and central zone. The zone of execution more effective was the right zone, due to a significantly lower number of errors in this zone.

The higher use of the right zone to execute the standing serve and jump power serve could be related to hand dominance and experience. Most of the players were right hand (95.8% in the sample studied). Therefore, serving from the right side of the court allowed player to direct the ball to the different areas of the opponent court with/o their rotation of her upper-body. In the jump serves (power and float), most of the serves were done close to the line. This could be related to the player want to be close to the area where she is going to defense and the arm swing. The jump float, with a smaller arm swing, was executed more in the left and central zones. The current study did not analyze the following actions that players did after serving. This type of serve may be used more by blockers in order to continue their pace to the net. It is possible as it was mention related to the criteria that players used to select the serve technique that their serves could be influenced by the action that they have to do after serving (e.g., block), the distance to cover, the fatigue¹⁰, or the psychological pressure of the game¹⁹.

Similar tendencies were found between the different serving techniques related to the destination zone. When the serve did not create displacement in the players at reception (because the serve goes to the player's location), there was a reduction in the serve efficacy,

due to principally to the significant increase of the serve that allowed the maximal options to the opponent team. However, when the serve moved the receptors there was an increase in the serve efficacy. This increase in efficacy was higher when the serve was directed to the zone between players. This ball trajectory increased the number of serves that limited the attack options or got point and reduced the number of receptions that allowed the maximal options to the opponent team. These results are similar to previous studies, in which the most effective destination was the trajectory in which the serve was directed to the zone between both receivers⁷. The jump serves that ended in zone closed to the net had a higher efficacy (significant occurrence of points). These results may be due to the ball touched the net and change the original trajectory what difficult the options to react for the players. The occurrence of this situation is low (<2-3%). This situation is not predictable. The introduction of the rule that allows the serve to touch the net was done in year 2000 with the intent of increasing the continuity in the game. This change brought, however, the possibility that the ball touches the net and fall directly to the court. The AVP is applying since 2016 a regulation to avoid this situation in the final moments of the match. Therefore, when a team reaches set- or match-point, if the serve touches the net and stays inbounds on the team in reception, the serving team has a second attempt to serve²¹.

No relationship was found between the serve technique and the result of the rally. The different types of serve per se did not unbalance the opponent offense or the rally. These results could be considered as normal due to the different types of serves presented similar efficacy. The performance of the opponent side-out depends on more aspects of the game, such as reception, set, attack and block. This is an area of the sports performance that needs to be more studied in beach volleyball, the contribution of the different actions to the game performance. Most of the studies currently available have analyzed the different actions in an isolated way or just the efficacy, and they do not analyze the interrelationship and levels of influence of the manner of execution, physical aspects, or contextual aspects of the game. The knowledge of these relationships will allow to increase the objective knowledge of this sport and provide better evidence-based knowledge to guide technical, tactical, physical training, and the analysis of the game.

The findings of this study provide information about how the different manner of execution and serve technique contribute to serve efficacy in elite female beach volleyball players. These results offer a usefulness reference values that coaches could apply in their trainings and in the preparation of specific competitions. Moreover, many players used different serve techniques, and this study offer key information about the manner of execution in these type of serves.

However, the results must be interpreted with caution due to the risk of some of the tendencies have changed and due to the fact that it was not considered the impact of other aspects of the game, such strategies, physical load, or game momentum. Some of the findings could be connected with how the players control the fatigue during the game or create miscommunication between opponents sending the ball to interference zones. Despite the limitations and delimitations, the findings showed the influence of the manner of execution and zone of realization and destination has on efficacy in elite players. Future studies should analyze how the strategies, quality of opposition, fatigue, role player, weather conditions, anthropometrical characteristics of the players, and game momentum influence the serve.

These studies should be considered the study of the game actions from a more holistic perspective to understand better the relationship between the different factors that affect performance in beach volleyball.

Conclusion

The manner of execution influences the serve efficacy. The different techniques presented similar levels of the efficacy. However, the way of realization changes for each serve. The results showed possible connections between the way of executing the serve with the following actions done by the players and the players' strategies to control their physical load. The findings show how the most effective destination was the zone between players, probability due to the players' displacement and interference between players. These values may be useful to guide to players training (e.g., exercise goals) or to evaluate players in competition. Future studies need to analyze the serve considering physical aspects, contextual variables such as the momentum of the game, the player's maturity and experience, and team/players strategies.

References

1. Palao JM, Hernández-Hernández E. Game statistical system and criteria used by Spanish volleyball coaches. *Int J Perf Anal Spor* 2014;14(2):564-573. Doi: 10.1080/24748668.2014.11868743
2. Medeiros A, Marcelino R, Mesquita IM, Palao JM. Performance differences between winning and losing under-19, under-21 and senior teams in men's beach volleyball. *Int J Perf Anal Spor* 2017;17(1-2):96-108. Doi: 10.1080/24748668.2017.1304029
3. Homberg S, Papageorgiou A. Handbook for beach volleyball. Aachen: Meyer & Mayer Verlag; 1995.
4. Selinger A, Ackermann-Blount J. Arie Selinger's power volleyball. New York: St. Martin Press; 1986.
5. Palao JM, Gutiérrez D, Frideres JE. Height, weight, body mass index, and age in beach volleyball players in relation to level and position. *J Sport Med Phys Fit* 2008;48(4):466-471.
6. Koch C, Tilp M. Beach volleyball technique and tactics: a comparison of male and female playing characteristics. *J Kines* 2009;41(1):52-59.
7. López-Martínez AB, Palao JM. Effect of serve execution on serve efficacy in men's and women's beach volleyball. *Int J Appl Sports Sci* 2009;21(1):1-16.
8. Yiannis L. Comparison of the basic characteristics of men's and women's beach volley from the Athens 2004 Olympics. *Int J Perf Anal Spor* 2008;8(3):130-137.
9. Koch C, Tilp M. Beach volleyball techniques and tactics: a comparison of male and female playing characteristics. *Kinesiology* 2009;41(1):52-59.
10. Medeiros A, Mesquita I, Marcelino R, Palao JM. Effects of technique, age and player's role on serve and attack efficacy in high level beach volleyball players. *Int J Perf Anal Spor* 2014;14:680-691. Doi 10.1080/24748668.2014.11868751
11. Jiménez-Olmedo JM, Penichet A, Martínez JA, Andreu E, Pérez-Turpín JA. Análisis del saque en jugadoras femeninas profesionales de voley playa. *Retos* 2014;25:76-79.
12. Anguera MT. Observational methods (general). In Fernández-Ballesteros R, editors. *Encyclopedia of Psychological Assessment*. London: Sage; 2003, p. 632-637.
13. Coleman JE, Neville B, Gordon B. A statistical system for volleyball and its use in Chicago Women's Association. *International Volleyball Review* 1969;17:72-73.
14. Palao JM, Manzanares P, Ortega E. Design and validation of an observational instrument for technical and tactical actions in beach volleyball. *Motriz* 2015;21(2):137-147. Doi: 10.1590/S1980-65742015000200004
15. Anguera MT. Manual de prácticas de observación. 3ed. Mexico City: Trillas; 1991.
16. Robinson G, O'Donogue P. A weighted kappa statistic for reliability testing in performance analysis of sport. *Int J Perf Anal Sport* 2007; 7: 12-19.
17. Palao JM, Valades D, Ortega, E. Match duration and number of rallies in men's and women's 2000-2010 FIVB World Tour Beach Volleyball. *J Hum Kinet* 2012;34(1):99-104. Doi: 10.2478/v10078-012-0068-7
18. Takeshi A, Shinichiro I, Kazuya S, Akihiro H. Aerodynamics of a new volleyball. *Procedia Engineering* 2010;2:2493-2498.
19. Stefanello JMF. Psychological competence in high performance Beach Volleyball: Synthesis and training recommendations. *Motriz* 2009;15(4):996-1008.
20. AVP [Internet]. Championships in Chicago debuts new rule trials [access in September 2016]. Retrieved from: avp.com/news/championships-in-chicago-debuts-new-rule-trials/

Authors' ORCID:

Ana Belén López-Martínez <https://orcid.org/0000-0001-8419-3599>

Jose Manuel Palao: <https://orcid.org/0000-0002-4332-772X>

Enrique Ortega: <https://orcid.org/0000-0003-0815-5317>

Antonio García-de-Alcaraz: <https://orcid.org/0000-0001-8210-4118>

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Author address: Ana Belén López Martínez. Faculty Catholique of San Antonio Murcia, av/ los Jerónimos S/N, Guadalupe, Murcia, Spain.