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# ORIGINAL

# PREDICTORS OF THE RECEPTION EFFICACY IN MEN'S WORLD VOLLEYBALL U-21 AND ABSOLUT

# PREDICTORES DE LA EFICACIA DE RECEPCIÓN EN VOLEIBOL MUNDIAL MASCULINO U-21 Y ABSOLUTO

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## ABSTRACT

The aim of the study was to understand which variables of the reception action predict reception efficacy in two different competition categories (U-21, absolute) in male volleyball. The study sample comprised 3,442 serve-reception actions: 1,894 performed by players in U-21 category (U-21 Men´s World Championship) and 1,548 performed by players in senior category (senior Men's World Championship). The variables considered as predictors were: receiver player, previous displacement of the receiver, type of reception, receiver position, reception technique reception zone. Logistic regression analysis showed that previous displacement of the receiver and reception technique were predictors of reception efficacy in both categories, U-21 and senior. Type of reception and reception zone were predictors of efficacy in the U-21 category, but not the senior category. Receiver position was predictive of efficacy uniquely for the senior. These may benefit the training process by favouring the design of specific tasks for each level of play.

**KEY WORDS:** performance, game analysis, reception.

## RESUMEN

El objetivo de la investigación fue conocer las variables de recepción que predecían su eficacia, en diferentes niveles de juego (U-21, absoluto) en voleibol masculino. La muestra del estudio estuvo compuesta 3442 acciones de recepción, de las cuales 1894 corresponden a categoría U-21 (U-21 Men´s World Championship) y 1548 a categoría absoluta (Absolute Men´s World Championship). Las variables del estudio fueron: *función del receptor, desplazamiento previo del receptor, tipo de recepción, posición del receptor, técnica de recepción, zona de recepción, eficacia de recepción*. El análisis de regresión logística multinomial mostró que, el *desplazamiento previo del receptor* y *la técnica de recepció*n fueron predictoras en ambas categorías, U-21 y absoluta; el *tipo de recepción* y *zona de recepció*n fueron predictoras únicamente en U-21; la *posición del receptor* fue predictora únicamente en absoluta. Dicha información puede ayudar al proceso de entrenamiento favoreciendo el diseño de tareas concretas para cada nivel de juego.

**PALABRAS CLAVE**: rendimiento, análisis del juego, voleibol, recepción.

## INTRODUCTION

Performance analysis is essential for high-level sports teams. In addition to helping with an overall comprehension of the game (O´Donoghue, 2010), it allows for a specific understanding of the variables that can influence the game via the provision of performance indicators (Peña, Rodríguez-Guerra, Buscà, & Serra, 2013). Performance analysis is now frequently conducted through match analysis and has a fundamental role in improving performance in a large number of sports (O'Donoghue & Holmes, 2015). Match analysis is conducted via notational analysis (Wright, Atkins, & Jones, 2012), a technique that allows

coaches to understand the negative and positive aspects of performance and thus to contribute to the optimal establishment of objectives (Hughes et al., 2012). Notational analysis has been used to evaluate athlete performance at different performance levels and across different sports. In the case of volleyball, there is a large body of research using match analysis. However, most of such studies have focused on actions that pursue scoring a point. Because of the nature and dynamics of the game in volleyball, actions that cannot directly result in scoring a point influence actions that do, and it is important to consider the interactions that occur between these actions (Hale, 2001). As such, it is necessary to conduct research focused on non-finalist actions such as placement, reception, and defence (Fernández-Echeverria, Mesquita, González-Silva, Claver, & Moreno, 2017).

In volleyball, serve reception has a second-order relationship with attack (Eom & Chuz, 1992) because attack performance largely depends on the efficacy of reception (Parsiaouras, Moustakidis, Charitonidis, & Kokaridas, 2010). As such, effective reception is considered vital for a team's success (Paulo, Zaal, Fonseca, & Araújo, 2016; Peña et al., 2013). Reception performance depends on anthropometric, psychological, and technical-tactical characteristics as well as coordination between players (Sellinger & Ackermann-Blount, 1985; Stamm, Stamm, & Thomson, 2005), the execution of the opponent's serve (Afonso, Esteves, Araújo, Thomas, & Mesquita, 2012), and maturational factors that can influence efficacy in different age groups (García-Alcaraz, Palao, & Ortega, 2014). The ability to perform the reception action can differentiate the quality of teams and is a fundamental action for teams to perfect in order to be successful (Marelić, Resetar, & Jankovic, 2004).

Although it is widely accepted that reception is important for the construction of offensive plays (Costa et al., 2018), it remains far less studied than other game actions. Of the small number of studies that have considered reception, some have focused on the form of the libero. Two such studies, focused on high-level players (Rentero, Joao, & Moreno, 2015) and players in formative stages (Sánchez, González-Silva, Fernández-Echeverría, Claver, & Moreno, 2019), have examined the influence of the libero in the attack (reception) and defence phases of the game. Other studies have analysed the reception action as a function of the opposing team's serve. Paulo et al. (2016), for example, aimed to understand which aspects of service and reception actions influenced players' choice of reception type and reception efficacy by requiring high-level players to receive float serves in different court zones (specifically zones one and five). Further studies have investigated how reception influences attack. As an example, Costa et al. (2018) analysed the effect of reception on the KI complex taking into consideration the performance level of the opposing team. It is, however, noteworthy that the majority of these prior investigations were conducted in the context of high-level volleyball. Moreover, studies attempting to understand how the characteristics of the reception action influence its efficacy are scarce.

Therefore, the primary aim of the present study was to analyse the reception-related variables predict reception efficacy at different levels (U-21 and seniors) in male volleyball.

## METHODS

### Sample

The study sample comprised 3,443 serve-receptions: 1,894 performed by players in the U-21 category (U-21 Men´s World Championship), and 1,548 performed by players in the senior category (senior Men´s World Championship). These actions were observed across 37 competitive matches, of which 14 were from the U-21 category and 23 from the senior category.

Five matches were observed for each of the four best-classified teams in the U-21 Men´s World Championship. This corresponds to the observation of 53 sets. Four matches were observed from the 12 best participating teams of the third phase of seniors Men´s World Championship, which corresponds to the observation of 87 sets.

### Variables

The study variables were:

*Receiver player*, the in-game role of the receiver player (Gil-Arias, Claver, Fernández-Echeverría, Moreno, & Moreno, 2016). The categories considered were: outside-hitter, defined as the receiver player has an offensive role and is positioned in the attack zone of the court (zones two, three, and four); libero, defined as receiver player is a specialist in defence and reception; and other, defined as receiver player has different role to the outside-hitter and libero.

*Previous displacement of the receiver,* defined as the movements made by the receiver player between the moment when the server makes the contact of the service, and when the receiver makes the reception (Paulo et al., 2016). In addition to the two types of displacement defined by Paulo et al. (2016) longitudinal (forward-backward), defined as forward-backward movement made by the receiver player; and lateral (left-right), defined as a left-right movement made by the receiver player. The present study included a third category; without displacement, defined as receiver player performs the reception without displacement (Ureña, Calvo, & Lozano, 2002).

*Type of reception,* defined as the position of the receiver in space when making contact with the ball. The categories considered were: two supports, receiver player makes contact with the ball with two feet on the ground; one support, receiver player makes contact with the ball with one foot on the ground; kneeling, receiver player makes contact with the ball with one or two knees on the ground; and without support, receiver player makes contact with the ball without touching the ground. Both feet are in the air (adapted from Carrero, Fernández-Echeverría, González-Silva, Conejero, & Moreno, 2017).

*Receiver position,* the height of the receiver player's arms when making contact with the ball (Miller, 2005, 55). The categories were: high, the receiver player

makes contact with the ball above the hips; medium, the receiver player makes contact with the ball between the hips and knees; and low, the receiver player makes contact with the ball below the knees.

*Reception technique,* defined as the technique used by the player when receiving the ball. Two categories were as defined by Barsingerhorn, Zaal, De Poel, y Pepping (2013) y Benerink, Bootsma, y Zaal (2015) and Benerink, Bootsma, y Zaal (2015): overhand reception (performed using the fingertips); and frontal forearm reception (performed using the forearms). Two further categories were also included: left lateral forearm reception (performed using the forearms, taking the arms to the left side); and right lateral forearm reception (performed using the forearms, taking the arms to the right side).

*Reception zone,* defined as the zone where the player receives the serve. The categories considered were: zone one, defined as the reception made in the lane of a 3 m x 9 m located at the right side of the court; zone six, defined as the reception made in the lane of a 3 m x 9 m located at the centre of the court; zone five, defined as the reception made in the lane of a 3 m x 9 m located at the left side of the court; and Space Between Players, defined as the reception is performed in an intermediate zone with conflict between two receivers (Gil et al., 2016).

*Reception efficacy,* defined as the outcome of reception. Efficacy was assessed using the categorization system from the Fédération Internationale de Volleyball (FIVB) and criteria from the "Data Volley System Valuation" software (Data Volley, 2010). These criteria have been used in prior research (García-de-Alcaraz et al., 2014; Palao, Santos, & Urena, 2006). The criteria were: reception does not provide attack options on first attempt (RNF), defined as reception that limits attack options); reception provides attack options on first attempt (RPF), reception allows all attack options; and error reception (ER), receiver does not make contact with the ball or receiver performs contact that cannot be recovered by the team.

**Procedure and data collection**

All the observed matches were filmed in their entireties. To obtain the best field of view when filming, the video recorder was located in one of the corners of the court. Once the data were collected, they were recorded with observational analysis software applied to volleyball, VA-Sports 1.0.75.

To ensure the reliability of the observation, one observer, an observer, who was a Graduate of Science in Physical Activity and Sports, National Level III volleyball coach, and who had five years of experience as a coach, conducted a training process. The intra-observer Cohen's Kappa coefficients for all variables were higher than .81 at the sixth training session, indicating almost perfect agreement (Fleiss et al., 2003). Specifically, the Cohen's Kappa coefficients for each of the variables were as follows: *receiver player* (.95), *previous displacement of the receiver* (.81), *type of reception* (.85), *receiver position* (.86), *reception technique* (.91), *reception zone* (.92), and *reception efficacy* (.81). To guarantee the temporal reliability of the measurement, the same

coding was performed on two occasions, with a time difference of 10 days. Cohen's Kappa values for this process were greater than .81.

## Statistical Analysis

Firstly, descriptive statistics were calculated for each of the study variables. Next, the association between each of the predictor variables and *reception efficacy* was tested through contingency tables with Chi-Square and Cramer's V statistics. Finally, multinomial logistic regression was used to test the influence of the predictor variables on *reception efficacy*. For all analyses, alpha was set at $p < .05$.

A test of multicollinearity was conducted prior to regression analyses to avoid including intercorrelated variables, although no variables required exclusion due to a lack of significant multicollinearity. All statistical analyses were performed using the statistical software package SPSS (version 18.0 for Windows, SPSS, Inc., Chicago, IL, EUA).

## RESULTS

Descriptive statistics are presented in Table 1. For the U-21 category, the majority of reception actions were performed by players other than the libero or outside-hitter (35.1%), without displacement (45.5%) and with both feet on the ground (62.4%). Receptions were also mostly performed in the high position (56.5%), using a frontal forearm reception technique (53.2%) in Zone six (35.9%), and most receptions provided attack options on the first attempt (RPF; 64.5%).

For the senior category, the majority of receptions actions were performed by players other than the libero or outside-hitter (38.0%), without displacement (47.0%) and with both feet on the ground (56.6%). For this category, receptions were mostly performed in the low position (16.1%), using a frontal forearm reception technique (58.3%) in zone six (44%), and most receptions provided attack options on the first attempt (68.5%).

**Table 1.** *Descriptive analysis of the study variables*

| Variables | Category | U-21 | | Senior | |
|---|---|---|---|---|---|
| | | n | % | N | % |
| **Receiver player** | Outside-hitters | 652 | 34.4 | 464 | 30 |
| | Other players | **664** | **35.1** | **589** | **38** |
| | Libero | 578 | 30.5 | 495 | 32 |
| **Previous displacement of the receiver** | Longitudinal | 612 | 32.3 | 454 | 29.3 |
| | Lateral | 421 | 22.2 | 367 | 23.7 |
| | Without displacement | **861** | **45.5** | **727** | **47** |
| **Type of reception** | One support | 210 | 11.1 | 163 | 10.5 |
| | Kneeling | 198 | 10.5 | 235 | 15.2 |
| | Without support | 304 | 16.1 | 274 | 17.7 |
| | Two supports | **1182** | **62.4** | **876** | **56.6** |
| **Receiver position** | High | **1071** | **56.5** | 182 | 11.8 |
| | Low | 90 | 4.8 | **259** | **16.1** |
| | Medium | 733 | 38.7 | 214 | 13.8 |
| **Reception technique** | Overhand | 555 | 29.3 | 182 | 11.8 |
| | Left forearm | 167 | 8.8 | 250 | 16.1 |
| | Right forearm | 164 | 8.7 | 214 | 13.8 |
| | Front forearm | **1008** | **53.2** | **902** | **58.3** |
| **Reception zone** | Zone one | 543 | 28,7 | 324 | 20,9 |
| | Space between players | 151 | 8 | 107 | 6,9 |
| | Zone five | 520 | 27,5 | 436 | 28,2 |
| | Zone six | **680** | **35,9** | **681** | **44** |
| **Reception efficacy** | RNF | 570 | 30.1 | 424 | 27.4 |
| | ER | 103 | 5.4 | 64 | 4.1 |
| | RPF | **1221** | **64.5** | **1060** | **68.5** |

Table 2 described the degree of association between reception-related variables and reception efficacy. For the U-21 category, the analyses revealed a significant association between *reception efficacy* and *previous displacement of the receiver, type of reception, receiver position, reception technique,* and *reception zone. Reception efficacy* and *receiver player* were not significantly associated, meaning *receiver player* was not included in the multinomial logistic regression model.

Although *receiver position* did present a significant association with *reception efficacy*, it did not meet the minimum criteria of the Chi-square test, and so was excluded from the final model.

For the senior category, there were significant associations between *reception efficacy* and *previous displacement of the receiver, receiver position* and *reception technique*. *Reception efficacy* was not associated with *receiver player*, *type of reception* or *reception zone*, and these variables were therefore excluded from the multinomial logistic regression model.

**Table 2.** *Association of reception efficacy with the study variables*

| Variables | U-21 | | | Senior | | |
|---|---|---|---|---|---|---|
| | ***p.*** | **$\square^2$** | **V de Cramer** | ***p.*** | **$\square^2$** | **V de Cramer** |
| **Receiver player** | .888 | 1.137 | .017 | .975 | .481 | .012 |
| **Previous displacement of the receiver** | **.021** | 11.538 | .055 | **.000** | 39.169 | .112 |
| **Type of reception** | **.000** | 27.881 | .086 | .099 | 10.687 | .059 |
| **Receiver position** | **.000** | 59.746 | .126 | **.026** | 11.096 | .060 |
| **Reception technique** | **.000** | 77.941 | .143 | **.000** | 88.196 | .169 |
| **Reception zone** | **.031** | 13.901 | .061 | .079 | 11.332 | .060 |

Table 3 and 4 present the regression models of the receiver-related variables for U-21 and senior categories.

For the U-21 category (Table 3), *previous displacement of the receiver, type of reception, reception technique,* and *reception zone* were significant predictors of *reception efficacy*. Specifically, when comparing reception provides attack options on first attempt with receptions does not provide attack options on first attempt, longitudinal displacement, as opposed to not moving, resulted in an increased reception efficacy by reducing the number of receptions does not provide attack options on first attempt compared to receptions provides attack options on first attempt.

In terms of *type of reception,* receptions without support were associated with a larger number of receptions does not provide attack options on first attempt and a decrease in reception efficacy.

Finally, in relation to the *reception technique*, overhand receptions resulted in increased reception efficacy, while receiving using the left and the right lateral forearms lead to decreased efficacy by increasing the number of receptions does not provide attack options on first attempt.

When comparing receptions provides attack options on first attempt and error receptions in the U-21 category (Table 3), *reception efficacy* was shown to increase when the *previous displacement of the receiver* was longitudinal or lateral compared to when the receiver did not move, as shown by the drop in error receptions compared to receptions provides attack options on first attempt. For *type of reception,* efficacy was shown to be worse (more error receptions compared to receptions provides attack options on first attempt) for receptions with one support, receptions while kneeling, and receptions without support compared to receptions with two supports.

In terms of *reception technique*, receiving with an overhand technique was more efficient that receiving with a frontal forearm technique, while receiving with a left lateral forearm technique reduced efficacy (more error receptions compared to receptions provides attack options on first attempt).

Finally, receiving in zone one resulted in less efficient reception compared to zone six through increased error receptions compared to receptions provides attack options on first attempt.

**Table 3.** *Adjusted model for reception efficacy in the U-21 category*

| Variables | RPF %[a] | RNF % | OR Crude | OR Ajusted. | *p* | ER % | OR Crude | OR Ajusted | *p* |
|---|---|---|---|---|---|---|---|---|---|
| **Previous displacement of the receiver** | | | | | | | | | |
| Longitudinal | 66.8 | 29.1 | .862 (.686-1.084) | .784 (.618-.995) | **.045** | 4.1 | .524 (.323-.848) | .387 (.234-.640) | **.000** |
| Lateral | 66.7 | 29.5 | .874 (.676-1.131) | .823 (.631-1.073) | .150 | 3.8 | .488 (.276-.861) | .422 (.233-.764) | **.000** |
| Receiver did not move[b] | . | . | . | . | . | . | . | . | . |
| **Type of reception** | | | | | | | | | |
| With a support | 59.5 | 29.5 | 1.159 (.834-1.612) | 1.225 (.871-1.724) | .244 | 11 | 3.333 (1.945-5.710) | 4.715 (2.613-8.507) | **.000** |
| While kneeling | 60.6 | 31.8 | 1.227 (.882-1.707) | 1.173 (.834-1.650) | .258 | 7.6 | 2.264 (1.222-4.195) | 2.017 (1.068-3.808) | **.031** |
| Without support | 58.9 | 34.2 | 1.358 (1.034-1.784) | 1.346 (1.015-1.785) | **.039** | 6.9 | 2.125 (1.233-3.663) | 2.563 (1.445-4.547) | **.001** |
| With two supports[b] | . | . | . | . | . | . | . | . | . |
| **Reception technique** | | | | | | | | | |
| Overhand | 72.8 | 25.9 | .823 (.650-1.042) | .762 (.593-.979) | **.034** | 1.3 | .175 (.080-.386) | .120 (.053-.273) | **.000** |
| Left lateral forearms | 47.9 | 39.5 | 1.905 (1.336-2.715) | 1.846 (1.289-2.645) | **.001** | 12.6 | 2.657 (1.542-4.578) | 2.272 (1.273-4.056) | **.006** |
| right lateral forearms | 48.2 | 45.7 | 2.192 (1.552-3.096) | 2.151 (1.511-3.063) | **.000** | 6.1 | 1.281 (.633-2.595) | 1.268 (.607-2.649) | .528 |
| Front forearms[b] | . | . | . | . | . | . | . | . | . |
| **Reception zone** | | | | | | | | | |
| Zone one | 62.4 | 29.5 | 1.032 (.803-1.327) | 1.036 (.803-1.337) | .786 | 8.1 | 1.746 (1.088-2.802) | 1.842 (1.125-3.015) | **.015** |
| Space between players | 65.6 | 33.1 | 1.105 (.757-1.613) | .977 (.658-1.451) | .909 | 1.3 | .272 (.064-1.152) | .272 (.062-1.189) | .084 |
| Zone five | 65.2 | 30.2 | 1.013 (.788-1.303) | 1.062 (.817-1.380) | .654 | 4.6 | .953 (.553-1.642) | 1.237 (.695-2.203) | .470 |
| Zone six[b] | . | . | . | . | . | . | . | . | . |

*"a" Category of references for the dependent variable, "b" Category of references for the independent variable. "c" 95% confidence interval*

For the senior category (Table 4), the *previous displacement of the receiver* and the *reception technique* were also predictive of *reception efficacy*. Specifically, when comparing receptions does not provide attack options on first attempt with receptions provides attack options on first attempt, moving before contacting the ball (longitudinally or laterally) lead to a reduced number of receptions does not provide attack options on first attempt: in other words, increasing reception efficacy.

In terms of *reception technique*, an overhand reception increased efficacy, while receiving using a left or right lateral forearm technique decreased efficacy by increasing the number of receptions does not provide attack options on first attempt compared to receptions provides attack options on first attempt.

When considering receptions provides attack options on first attempt versus errors reception (Table 4), *reception technique* and *receiver position* were

significant predictors of *reception efficiency*. Specifically, when comparing error receptions with receptions provides attack options on first attempt the lateral forearms techniques (compared to frontal forearm techniques) and low position (compared to medium position) were linked to increased error receptions, thus indicated a decrease in *reception efficacy*.

**Table 4.** *Adjusted model for reception efficacy in the senior category*

| Variables | RPF %[a] | RNF % | OR Crude | OR Ajusted | *p* | ER % | OR Crude | OR Ajusted | *p* |
|---|---|---|---|---|---|---|---|---|---|
| **Previous displacement of the receiver** | | | | | | | | | |
| Longitudinal | 75.1 | 22 | .521 (.397-.648) | .582 (.439-.770) | **.000** | 2.9 | .442 (.232-.844) | .520 (.268-1.008) | .053 |
| Lateral | 75.7 | 20.7 | .486 (.361-.655) | .502 (.369-.685) | **.000** | 3.5 | .543 (.284-1.037) | .605 (.310-1.181) | .141 |
| Receiver did not move[b] | . | . | . | . | . | . | . | . | . |
| **Receiver position** | | | | | | | | | |
| High | 42.1 | 42.7 | 1.070 (.845-1.354) | 1.159 (.875-1.533) | .304 | 42.2 | 1.264 (.727-2.198) | 1.232 (.664-2.286) | .508 |
| Low | 6.7 | 8.7 | 1.374 (.895-2.109) | 1.386 (.893-2.152) | .146 | 17.2 | 3.236 (1.533-6.830) | 3.389 (1.579-7.273) | **.002** |
| Medium[b] | . | . | . | . | . | . | . | . | . |
| **Reception technique** | | | | | | | | | |
| Overhand | 85.7 | 13.2 | .469 (.297-.740) | .471 (.284-.780) | **.003** | 1.1 | .301 (.071-1.278) | .329 (.072-1.502) | .151 |
| Left lateral forearms | 51.6 | 40.4 | 2.385 (1.763-3.227) | 2.269 (1.637-3.146) | **.000** | 8 | 3.643 (1.991-6.666) | 3.577 (1.855-6.899) | **.000** |
| Right lateral forearms | 54.7 | 38.8 | 2.161 (1.568-2.978) | 1.998 (1.422-2.807) | **.000** | 6.5 | 2.812 (1.437-5.501) | 2.715 (1.331-5.535) | **.000** |
| Front lateral forearms[b] | . | . | . | . | . | . | . | . | . |

*" a" Category of references for the dependent variable, "b" Category of references for the independent variable, "c" 95% confidence interval*

## DISCUSSION

At present, we find studies that show that reception, despite being an intermediate action, has a fundamental role in the construction of the attack (Palao et al., 2006; Silva, Lacerda, & João, 2013), affecting decisively the quality of it (Eom & Schutz, 1992). With the aim of obtaining information to improve the reception training process, the present investigation sought to know which reception variables predicted the efficacy of said action, at different levels of play, in volleyball

The descriptive analysis demonstrated substantial similarity between the U-21 and senior categories across the reception-related variables (*receiver player, previous displacement of the receiver, type of reception, reception technique, reception zone)*, although the categories differed in terms of *receiver position*. For both categories, reception actions were performed most frequently by players other than the libero or outside hitter, without displacement, with two supports, using the front forearms and in Zone six. Most reception actions for both groups provided attack options on the first attempt. However, while reception actions were mostly performed in the high position in the U-21 category, for the senior category they were predominantly performed in the low position.

These results are consistent with prior studies that have shown senior-category receivers are most likely to perform the reception action using a forearm technique (89%) without displacement (72.9%) (Ureña et al., 2002), and to do so most commonly in zone six (51.4%) (Rentero et al., 2015). Past research has also demonstrated that high-level players mostly perform excellent, highly efficient receptions (Costa et al., 2017). However, the findings of the present study contrast with research that has shown players from junior categories most frequently perform the reception action with either a single support or no support (52.7%).

The results of the regression analysis indicate that the *previous displacement of the receiver* and the *reception technique* were predictive of *reception efficacy* at both the U-21 and senior levels. Additionally, the *type of reception* and *reception zone* were predictive of *reception efficacy* at the U-21 level, but not the senior level, while the *position of the receiver* was predictive of *reception efficacy* at the senior level, but not the U-21 level.

For the U-21 and senior level, the *previous displacement of the receiver* was predictive of *reception efficiency*: prior longitudinal and lateral displacements were associated with increased *reception efficiency*. These results contrast with a study of high-level male volleyball players that found chances of success were less than perfect when a receiver moved to perform a reception (Paulo et al., 2016). It is, however, possible that the results of Paulo et al were conditioned by the characteristics of the test used (a task created specifically for the study), as well as by the small number of subjects (8).

Barsingerhorn et al. (2013) has highlighted that moving after a service to reach a specific position and send the ball to the setter is complex. Indeed, these authors indicated that arriving at a specific place at a specific time depends on multiple factors, including the speed of the player's movement, the time available, and the trajectory of the ball in relation to the player.

Nevertheless, our results showed that when receivers moved, they were performed more efficient receptions than when they did not, and this was true for both categories of play. This may be because servers tend to aim for specific areas, such as back lines (Moreno, García de Alcaraz, Moreno, Molina, & Santos, 2007) or interference zones (López-Martínez & Palao, 2009), in order to make their serves more difficult to receive. Players thus become accustomed to having to move to perform a serve-reception out of necessity, and this naturally leads to an increase in reception efficacy. It is noteworthy that because the players participating in the current study were members of a national team, they were playing at a higher level than most other players.

*Reception technique* was also a significant predictor of *reception efficacy* for both the U-21 and senior categories. Overhand receptions were associated with increased efficacy, while using a lateral forearms technique, as opposed to using a frontal forearm technique, was linked to reduced efficacy. We are not aware of any prior studies linking *reception technique* to *reception efficacy* in

this manner. However, Afonso et al. (2012) have shown that reception using the forearms increased the number of receptions that did not allow the team to develop an attack by failing to send the ball to an ideal setting zone.

When the serve is directed to the back of the court, or at the chest of the receiver player, it can be very difficult for the receiver to perform a frontal forearm reception. On such occasions, it may be necessary to use an emergency technique or other advanced techniques (Shondell, 2002). Although the use of these techniques is usual, their use is associated with non-ideal playing conditions. As a consequence, even if the correct technique is performed, it often affects the reception by decreasing its efficacy.

Variables related to *type of reception* and *reception zone* were predictive of *reception efficacy*, but only for the U-21 category. In terms of *type of reception*, we found that receiving with one support, receiving while kneeling, and receiving without support was associated with lower reception efficacy than receiving with two supports. These results are consistent with those of a recent study, focused on the U-19 category, which found more poor receptions when receiving without support (Carrero et al., 2017). Indeed, according to Dearing (2003), the success of a reception pass depends on the position of the player's feet, and receptions not performed with two supports are less efficient.

As indicated previously, *reception zone* was a receiver-related variable linked to *reception efficacy* for the U-21 category, although not the senior category. Our results showed that receptions in zone one was less effective than those in zone six. Consistent with our results, despite not having the same distribution in terms of zones, Joao and Pires (2015) showed that reception actions were more effective when performed in central zones of the court.

Although the majority of serves are usually directed towards the central zone of the court (Rentero et al., 2015), it is here where the principle receivers, the libero (Joao & Pires, 2015) or outside hitter, are positioned. Coupled with this, serves made to the central zones are usually performed with the objective of minimizing risk and securing the same (Gil et al., 2016), thus making these serves easier to receive. Taken together, it is clear why receiving in central zones of the court would favour more efficient reception actions.

Turning our attention to the results from the senior category it is evident that the only category-specific receiver-related predictor was *receiver position*. Specifically, efficacy was reduced when receptions were performed in the low position, as indicated by a greater number of error receptions compared to receptions that allowed the team to build an attack on the first attempt.

The optimal contact height of the ball with the arms is between the knees and the waist (Miller, 2005). This is not the case when players receive from a low position, during which the arms are typically below the knees and close to the ground, thus accounting for why they are less effective.

## CONCLUSIONS

For both the U-21 and senior categories, reception actions were most frequently performed; by a player other (receiver player has different role to the outside-hitter and libero), then the libero or outside hitter; without prior displacement; with two feet planted on the floor; and using a frontal forearm technique. The majority of receptions were efficient, providing attack options on the first attempt. Reception actions differed between the U-21 and senior categories in terms of receiver position. While receptions were mostly performed in the high position in the U-21 category, they were more commonly performed in the low position in the senior category. Reception-related variables were predictive of reception efficacy. For both categories, the *previous displacement of the receiver* and the *reception technique* were found to be associated with efficacy. In addition, *type of reception* and *reception zone* were linked to efficacy in the U-21 category, but not the senior category. Conversely, the *receiver position* was associated with efficacy in the senior category, but not the U-21 category.

These results offer valuable information about the aspects of reception that influence reception efficacy at two different game categories. As such, the study findings can be used to guide and optimize the reception training process at different levels of play.

*NOTE: This article is part of a series of articles belonging to the Doctoral Thesis entitled "Analysis of the variables that affect in the reception and setting in volleyball", carried out by Ms. Jara González Silva, at the University of Extremadura.*

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