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ORIGINAL

SETTER'S ACTION RANGE AS A PERFORMANCE INDICATOR IN MALE VOLLEYBALL

RANGO DE ACCIÓN DEL COLOCADOR COMO INDICADOR DE RENDIMIENTO EN VOLEIBOL MASCULINO

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ABSTRACT

This study aimed to check if the ideal setting zone is the most frequently used, to compare this zone with the Average Position of the setter with middle blocker availability (AP) and to verify if the distance between both can be considered a performance indicator. 2291 actions of the top-12 teams in the 2010 Men's Volleyball World Championship were analysed. The position (latitude and depth) of the setter was registered. The AP and the distance with the ideal setting zone were calculated. The reception efficacy was retrieved from the FIVB. Spearman's Rho was obtained through a correlation. Results confirm the area of latitude 6 and depth 1 as the most successful. Nevertheless, teams are able to maintain first tempo availability despite moving the setter out of it. The distance between the AP and the ideal setting zone correlates to the final ranking more than the reception efficacy.

KEY WORDS: match analysis, middle blocker, setter, average position, action range, distance, volleyball.

RESUMEN

Este estudio buscó comprobar si la zona ideal de colocación es la más usada, comparar dicha zona con la Posición Media (AP) del colocador con disponibilidad de primer tiempo y verificar si la distancia entre ambas puede considerarse un indicador de rendimiento. Analizamos 2291 acciones de los 12 mejores equipos del mundial masculino de voleibol (2010). Registramos la posición (latitud y profundidad) del colocador. Calculamos su AP y la distancia a la zona ideal. Recogimos la eficacia de recepción desde las estadísticas de la FIVB. Una correlación aportó la Rho de Spearman. Los resultados confirman el área de latitud 6 y profundidad 1 como la más exitosa, pero los equipos pueden contar con primer tiempo cuando el colocador sale de ella. La distancia entre la AP con disponibilidad de primer tiempo y la zona ideal de colocación correlaciona con la clasificación final más que la eficacia de recepción.

PALABRAS CLAVE: análisis de juego, central, colocador, posición media, rango de acción, distancia, voleibol.

1. INTRODUCTION

In team sports, success depends on the cooperative interaction of their individuals. The collective performance is different than the sum of the individual actions, since players' behaviour is constantly limited by a large number of variables. This means that tactical systems are limited by diverse factors that produce multiple effects, which is a general characteristic of complex systems (Duarte, Araújo, Correia, & Davids, 2012).

In male volleyball, the speed of the game has become a key factor. In first tempo attacks the hitter jumps during or immediately after the set, whereas in second tempo attacks players take two steps after the set (Afonso, Mesquita, Marcelino, & Silva, 2010). The importance of the middle attacker's participation in quick attacks (i.e. first tempo attacks) is well established as a predictor of success (Asterios, Kostantinos, Athanasios, & Dimitrios, 2009; Palao, Santos, & Ureña, 2007; Zetou, Moustakidis, Tsigilis, & Komninakidou, 2007). Besides, when combined with a second tempo attack, first tempo attacks become even more important (Marcelino, César, Afonso, & Mesquita, 2008).

Notwithstanding, in order to play fast, teams must perform high quality first contacts (i.e. receptions), both in professional and young players (Marcelino, Afonso, Cicero Moraes, & Mesquita, 2014; Sánchez, González-Silva, Fernández-Echeverría, Claver, & Moreno, 2019). As a consequence, serve reception is considered a predictor of both attack success and team's performance in general (Costa, Barbosa, & Gama Filho, 2013; Costa, Mesquita, Greco, Ferreira, & Moraes, 2011; Nikos & Elissavet, 2011; Ureña, 1998).

Traditionally, the success of the first contact has been assessed through the precision of the pass in certain areas (Afonso, Esteves, Araujo, Thomas, & Mesquita, 2012; Zetou et al., 2007) or the number of attackers available (Castro et al., 2011). However, as aforementioned, searching for linear indicators without considering the dynamic nature of the game does not provide sufficient information about the context of the game (Duarte et al., 2012). For this reason, more complex and non-linear indicators should also be born in mind, such as the available options of attack, being the middle blocker availability the most determining one (Costa et al., 2013; Costa et al., 2011; João, Mesquita, Sampaio, & Moutinho, 2006), the decision making (Conejero Suárez, Claver Rabaz, Fernández-Echeverría, Gil-Arias, & Moreno Arroyo, 2017), or the style of play of any particular team (Sánchez-Moreno, Mesquita, Afonso, Millán-Sánchez, & Ureña, 2018).

An interesting avenue of research could entail the study of the setter's possibility for interacting with the first tempo hitter: Is it universal? Is it dependent on the precision of the reception? Can a radio of action be established? Can this radio vary from one team to another? From these uncertainties, we intend to discriminate teams according to first tempo attack availability, based on spatial factors, as an alternative to assessing the quality of the reception according to the ideal setting zones exclusively (Afonso et al., 2012; Costa et al., 2013; Costa et al., 2011; Zetou et al., 2007). Likewise, we

want to determine whether the measurement of this availability can be considered a performance indicator.

Thus, the objectives of this study were: 1) to check if the ideal setting zone is the most frequently used setting zone, 2) to compare the ideal setting zone with the Average Position of the setter of each team with middle blocker availability and 3) to verify if the distance between the ideal setting zone and the Average Position of the setter can be considered a performance indicator.

2. MATERIAL AND METHODS

2.1. Sample

The International Volleyball Federation's (FIVB) 2010 Men's Volleyball World Championship in Italy was analysed, with a total of 23 matches and their corresponding 76 sets (30% of the total championship). The sample was represented by 12 nationalities (sorted by ranking): Brazil, Cuba, Serbia, Italy, Russia, USA, Bulgaria, Germany, Argentina, Czech Republic, France and Spain. Following the criteria of Afonso et al. (2010), the variables were registered only in those plays in which the team in reception (Complex 1) had a middle blocker that was available to perform a quick attack, regardless of whether he executed it or not, resulting in 2291 actions.

This study was approved by the Ethics Committee for Human Research at the University of Granada.

2.2. Variables

The *Latitude* (from 1 to 9) and *Depth* (from 1 to 9) of the setter's final position when there was first tempo availability were recorded. To provide better insights in game success we propose a new indicator, the *Average Position* (AP) of the setter (*cx, cy*), which was calculated for each of the teams in two different analysis (Equation 1):

a) AP1: average position of the setter whenever the front-row middle blocker was available.

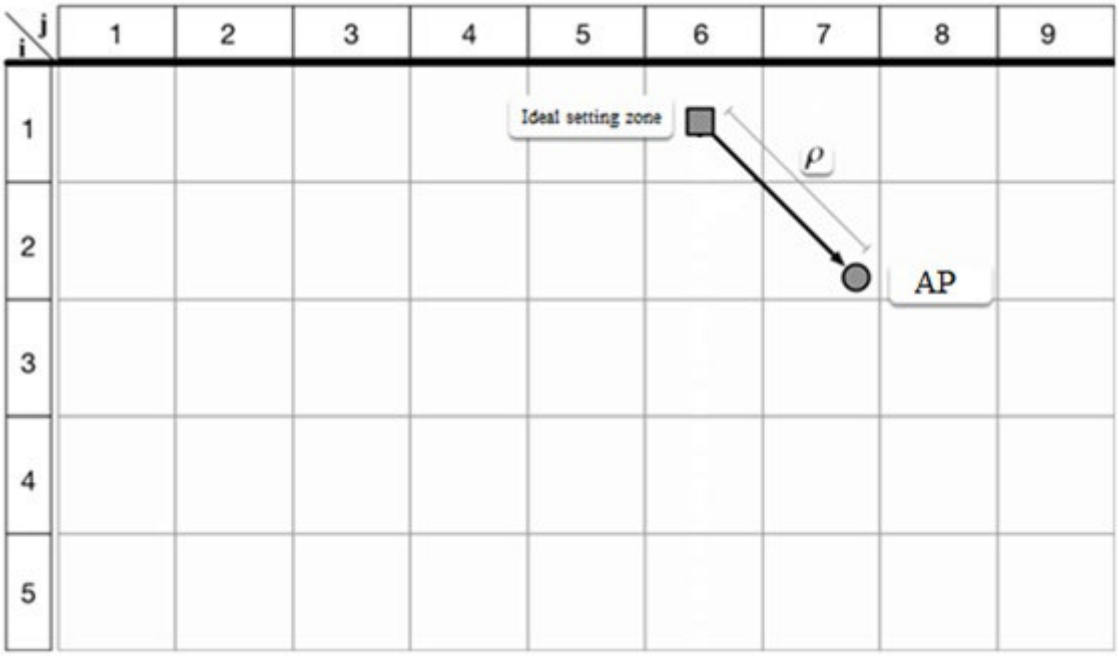
b) AP2: average position of the setter whenever the front-row middle blocker was available and there was an attack point in the Complex 1 (attack point/total attacks).

$$(c_x, c_y) = \sum_{i=1}^{5} \sum_{j=1}^{10} (i \cdot f_{i,j}, j \cdot f_{i,j})$$

Equation 1. Formula for the AP.

The ideal setting zone is defined as the centre of the zone where the set should ideally be performed (Afonso et al., 2012), and was established in the centre of the one-square-metre cell of latitude 6 and depth 1 (5.5, 0.5) (Figure 1).

The variable Distance (ρ) was defined and calculated as the Euclidean distance between the ideal setting zone and the AP of the setter of each team (Figure 1), utilising Equation 2. It summarises the setter's action range with availability of first tempo (SARA). Therefore, two different distances were calculated. Besides, the distance between both AP was calculated to measure the difference between the AP1 and the AP2 (Distance 3):



$$\rho = \sqrt[2]{|xc - xp|^2 + |yp - yc|^2}$$

Equation 2. Formula to calculate the Euclidean distance.

The *attack outcome* was registered only when there was an *attack point*, which was considered for *AP2*.

The *mean efficacy of the reception* was collected from the FIVB's statistics for the championship (http://www.fivb.com/).

2.3. Design and procedure

The video recording of the matches was done with a camera set at a height between 3 and 7 metres and between 10 and 15 metres from the court.

For the observational analysis, the VA-Sport software (version 1.0.74) was utilised (http://masvb.com/software.html). The *Latitude* and *Depth* were registered through the use of an adjustable grid (Figure 2) of 9 m x 9 m in order to assess the setter's exact position in the setting action of each side-out phase.

In order to determine the reliability, 10% of the sample was randomly selected and analysed (Tabachnick, Fidell, & Osterlind, 2007). The values of Cohen's Kappa (Cohen, 1960) for the intra-observer and inter-observer reliability were higher than 0.75 for all the variables. The values proposed by Fleiss (2003) were used as a reference.

2.4. Statistical analysis

For the descriptive treatment of the data, a study of frequencies and percentages was utilised. To determine whether there was an association between the variables, the values of Spearman's Rho were obtained through a bivariate correlation. Significance was set at $p<0.05$. The effect size was also analysed through correlation coefficients following the thresholds proposed by Cohen (1988). The calculation of the distances and AP was completed with the software environment for statistical computing, R, and various packages available on CRAN (https://cran.r-project.org) and github (https://github.com/manuparra/volleyball-performance-analysis). The statistical package SPSS v.22 for Windows and R (v.3.2.3) along with RStudio's IDE for Linux were utilised.

3. RESULTS

A frequency analysis of the setter's position in receptions that allowed first tempo attacks was carried out. With regard to the latitude, from a total of *N*= 2291 sets, 42% of the cases were in latitude 6, 24% in latitude 7 and 20% in latitude 5. Regarding depth, 55% of the cases took place in depth 1, 31% in depth 2 and 12% in depth 3.

The ranking, reception efficacy and the distance, latitude and depth of each AP for all the teams are shown in Table 1. Regarding reception efficacy, France presented the highest (0.706) and Bulgaria the lowest (0.566). For both, attacks with middle blocker availability (*Distance 1*) and attack points with middle blocker availability (*Distance 2*), Cuba had the largest (1.4675 m and 1.4701 m)

and France the smallest (1.0491 m and 0.9913 m). The largest *Distance 3* was 0.18 m, for USA, and the smallest 0.03 m, for Italy.

Table 1. Ranking, reception efficacy, distances and average positions coordinates for each team.

Ranking	National team	Reception efficacy	Distance 1 (m)	AP1 coordinates (lat, dep)	Distance 2 (m)	AP2 coordinates (lat, dep)	Distance 3 (m)
1	Brazil	0.699	1.1687	6.127, 1.486	1.0832	6.000, 1.461	0.13
2	Cuba	0.585	1.4675	5.991, 1.883	1.4701	6.087, 1.848	0.10
3	Serbia	0.573	1.3577	6.045, 1.744	1.3096	6.052, 1.687	0.06
4	Italy	0.602	1.2530	5.961, 1.665	1.2469	5.983, 1.650	0.03
5	Russia	0.660	1.2054	6.024, 1.585	1.2319	6.184, 1.524	0.17
6	USA	0.666	1.3958	6.067, 1.775	1.3658	5.886, 1.810	0.18
7	Bulgaria	0.566	1.3028	6.056, 1.678	1.2400	5.990, 1.639	0.08
8	Germany	0.627	1.2687	5.785, 1.736	1.1258	5.696, 1.609	0.16
9	Argentina	0.638	1.2574	6.368, 1.410	1.1900	6.341, 1.341	0.07
10	Czech Rep.	0.699	1.1554	5.995, 1.544	1.0670	6.000, 1.443	0.10
11	France	0.706	1.0491	6.125, 1.343	0.9913	6.097, 1.291	0.06
12	Spain	0.672	1.0775	5.753, 1.547	1.1046	5.873, 1.540	0.12

As seen in Figure 3, the ideal setting zone (6, 1) meets the most frequent setting zone with middle blocker availability for all teams except Cuba (6, 2), Germany (6, 2) and Spain (5, 1).

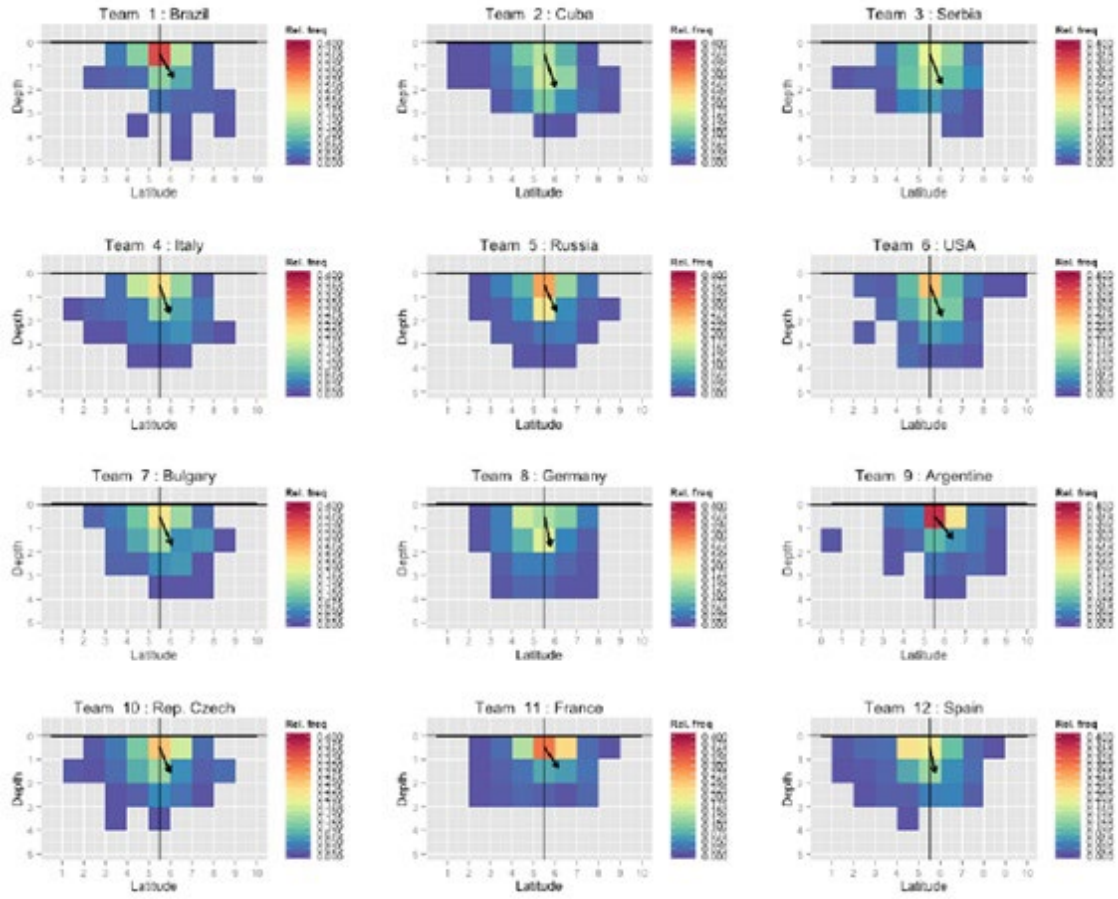
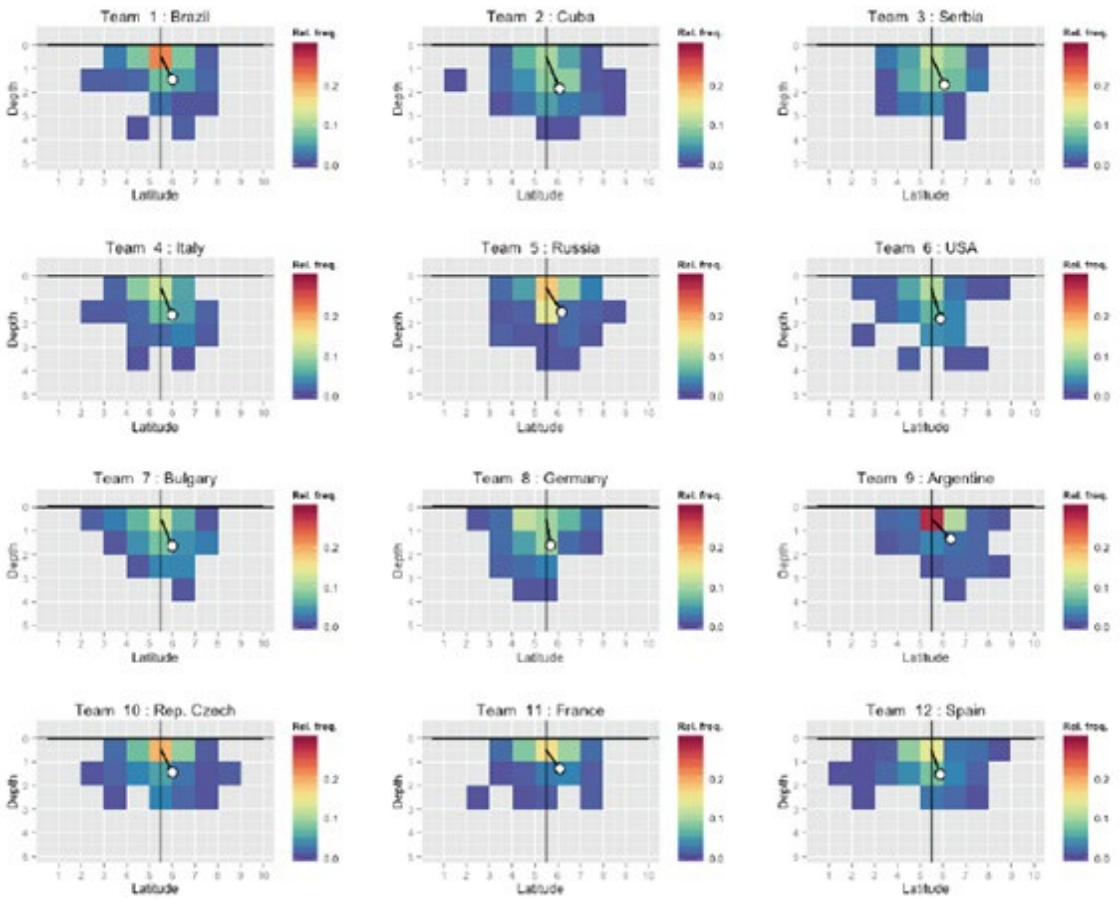


Figure 3. Frequency distribution of setting zones with middle blocker availability and AP1.

Similarly, the ideal setting zone (6, 1) meets the most frequent setting zone when there is an attack point provided that there is first tempo availability for all teams except Germany (5, 1) (Figure 4).



Frequency distribution of setting zones with middle blocker availability and attack point and AP2.

The values of Spearman's Rho bivariate correlation between the variables are shown in Figure 5. Between the ranking and the reception efficacy there was a correlation of r_s = -0.42. The correlation between the ranking and the Distance 1 the correlation was r_s = 0.55, and with the Distance 2 it was r_s = 0.59 ($p < 0.05$). Regarding the reception efficacy, its correlation with the Distance 1 was r_s = -0.77 ($p < 0.01$) and with Distance 2 r_s = -0.76 ($p < 0.01$). The correlation between both distances, 1 and 2, was r_s = 0.93 ($p < 0.001$).

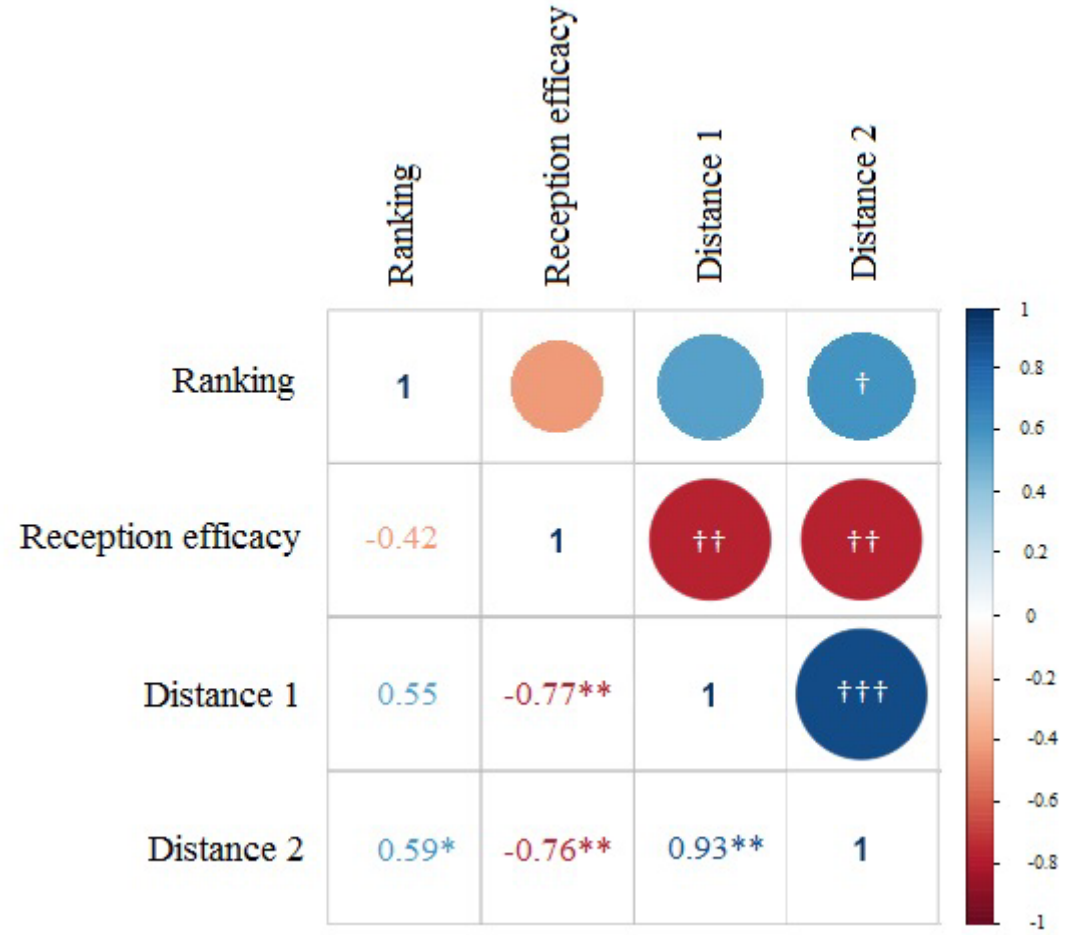


Figure 5. Correlation of the variables Ranking, Reception efficacy, Distance 1 and Distance 2. *Large effect size; **Really large effect size. (Cohen, 1988). † p < 0,05; †† p < 0,01; ††† p < 0,001.

4. DISCUSSION

As highlighted by Afonso et al. (2010), the availability of the middle blocker for first tempo attacks is crucial for the attack to be agile and offensive, as long as there is an adequate spatial relationship between the setter and the middle blocker. First tempo attacks have hitherto been expressed as part of the number of attacks available for a team (Castro et al., 2011). Other studies have assessed the distance between the setter and the middle blocker when performing a first tempo attack (Marcelino et al., 2014; Sapena Peiro et al., 2016). With our study, we have intended to measure quantitatively the area in which this attack is viable. In order to measure spatial variables, research in other sports (i.e. football) has used the concept of centroid, which has been found useful to describe the distribution of players (Folgado et al., 2014; Frencken et al., 2011; Goncalves et al., 2014; Silva et al., 2014). However, they have utilised it as a dynamic area that changes depending on the position of the players on the field. Our contribution derives from this concept in terms of measuring spatial usage, but it is presented as a fixed point that summarises the average position of one player in the moment the set is performed.

One of our aims was to compare the ideal setting zone with the AP of the setter of each team with middle blocker availability. In order to do so, we obtained a distance that corresponds to the setter's action range with availability of first tempo (SARA). The ideal setting zone was established following the references by Fellingham et al. (2013) and Afonso et al. (2012). However, for a more accurate data and in order to assess the exact position of the setter, we divided the volleyball field into a 9x9 m grid. As seen in Figure 3 and 4, our results confirm that, when having first tempo availability, the cell of latitude 6 and depth 1 is the most frequent setting zone. In this level, teams aim to place their receptions in this area, ratifying it as the ideal setting zone. Regarding SARA, from our results, it can be inferred that the spatial relationship between setter and middle blocker varied in function of the team and its area of availability of the first tempo. Therefore, it might be interesting to use this indicator as a descriptor of the tactical analysis, given that it differentiates the unique capacity of each team to adapt to their reception performance.

The lowest reception efficacy was 0.566 (for Bulgaria) and the highest 0.706 (for France). The largest distances, both 1 and 2, were presented by Cuba, and the smallest by France. When correlating these data to the final ranking, where Cuba finished in second position and France in eleventh position, a correlation of r_s = -0.42 between ranking and reception efficacy and of r_s = 0.55 between ranking and Distance 1 was found. However, these associations were not statistically significant, which could be explained by the small sample utilised. Only the correlation between ranking and Distance 2 (r_s = 0.59) showed statistical significance ($p<0.05$). Therefore it could be assumed that larger areas of first tempo availability might increase the likelihood of success in the final ranking, despite a worse reception efficacy, although this statement should be considered with caution, since there could be affecting variables not included in this study.

This could be explained by the correlations between reception efficacy and both Distance 1 (r_s = -0.77; $p<0.01$) and Distance 2 (r_s = -0.76; $p<0.01$), meaning that teams that presented a lower reception efficacy could be adapting to the game requirements by enlarging their area of first tempo availability, thus allowing them to achieve a higher ranking. On the other hand, teams with a better reception efficacy cannot maintain their first tempo attacks when the setter must perform farther from the ideal setting zone. This could come as a consequence of the teams' adaptation to the dynamic nature of the game. According to McGarry et al. (2002), a complex system has the property of self-reorganization in response to the changes in the elements that make up the system. As an example, in previous studies, it has been shown that teams might present different styles of play (i.e. more direct or more elaborate) according to their characteristics (Sánchez-Moreno et al., 2018). Similarly, they could be increasing their area of first-tempo availability as a consequence of a lower reception efficacy, being able to maintain an efficient attack, as opposed to what happens among young players, where the reception efficacy appears to predict the following attack (González-Silva, Moreno Domínguez, Fernández-Echeverría, Claver Rabaz, & Moreno Arroyo, 2016). Furthermore, the Distance 3, meaning the distance between AP 1 and 2, was very small (varying between 0.03 and 0.18 m) and showed high correlation (r_s = 0.93; $p<0.001$). In other

words, the AP of the setter when there is first-tempo availability and when there is an attack point were quite close; hence, a reception that allows teams to make use of their middle blockers plays a fundamental role in their success, confirming previous results (Asterios et al., 2009; Zetou et al., 2007).

Future research should check the features of this new indicator we have denominated as SARA in other samples, such as examining whether it is related to the final ranking of the teams in a female sample as well or determining if the ideal setting zone is the same in younger stages of learning and non-professional players. Furthermore, our sample dates from 2010, and the evolution of the game might have caused changes in the relationship between the setter and the middle blocker throughout the last years. On another level, our results have shown large and really large correlations (Cohen, 1988), despite the lack of significance of some of them. Similar studies with larger samples are needed in order to solve this problem.

5. CONCLUSIONS

Our results have established the area of latitude 6 and depth 1 as the most frequent setting zone for most of the high level male volleyball teams, confirming the assumption of this area as the optimal for the success. Notwithstanding, elite male volleyball teams are able to maintain first tempo availability despite moving the setter out of this ideal setting zone. We have proposed the Average Position of the setter and its distance to the ideal setting zone, meaning the Setter's Action Range with Availability of first tempo (SARA) as a new variable in order to study its relationship with the final ranking. According to our data, the distance between the AP of the setter with availability of first tempo attack and the ideal setting zone has proven to correlate to the final ranking of the team more than the reception efficacy. Hence, this new measure might be considered as a performance indicator in elite male volleyball.

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