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Tim McGarry, Peter O’Donoghue, Jaime Sampaio

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INDOOR VOLLEYBALL AND BEACH VOLLEYBALL

Isabel Mesquita¹, José M. Palao², Rui Marcelino¹ and José Afonso¹

¹ UNIVERSITY OF PORTO, PORTUGAL
² UNIVERSITY OF MURCIA, SPAIN

Summary

Research on performance analysis in volleyball arose systematically in the literature in the 1990s. This chapter will present the different conceptual perspectives used to study indoor volleyball and beach volleyball performance using notational analysis, taking into account technical and tactical indicators. In this field, chronological analyses have evolved from studies applying descriptive designs to ones with an emphasis on correlation analysis. Recent research in the field of notational analysis tends to follow Thelen’s (2005) recommendations, and instead of establishing simple cause-and-effect relationships, it embraces the possibility of profuse non-linear interactions. This supports the need for an ecological approach, considering the match as a complex dynamical system. Studies on indoor volleyball have been progressing in this direction and assessing sequences of events and their timeline, as well as the context of their use. However, beach volleyball is still in the initial stages that indoor volleyball has already gone through. Likewise, studies are becoming more sophisticated in order to contribute to performance modelling, attending to the dynamics and complexity of the game. Moreover, a synthetic description of the characteristics, advantages, and limitations of some available systems that have been specifically designed for performance analysis in indoor volleyball and beach volleyball will be presented, as well as trends for future research in this field.

Introduction

Analysing a team’s performance is imperative for optimizing the preparation process and for assisting in the development of concepts and strategies capable of stimulating improvement in the team’s efficacy (Jäger and Schöllhorn, 2007). Indeed, notational analysts and coaches commonly employ performance indicators to assess individual and team performances (Hughes and Bartlett, 2002). Research in performance analysis (PA) focused on volleyball has been providing thorough information on the features, patterns, and specificities of teams’ behaviours within competitive contexts, providing valuable data for guiding practice and research alike. In indoor volleyball, this trend emerged earlier than in beach volleyball. However, although research
lines and methodologies are similar, the state of knowledge and number of studies are greater in indoor volleyball.

This chapter attempts to synthesize evolutionary trends of research in this field, identifying the most common research questions emerging from PA investigation in indoor volleyball and beach volleyball, and also to characterize the most commonly used methods to analyse the data.

**Indoor volleyball performance analysis: methodological tools and technical and tactical indicators**

Several online databases were searched, including SportDiscus, PubMed, Web of Science, and Medline. Key search terms used included ‘volleyball’, ‘game analysis’, ‘match analysis’, ‘notational analysis’, ‘performance analysis’, ‘performance indicators’, ‘tactical analysis’, and ‘video analysis’. Manual searches were also conducted using the reference lists from the recovered papers. Methodologically, a content analysis strategy was applied. Consequently, 87 papers were selected that fulfilled three criteria: to have been pioneering in the approached themes; to have presented relevant trends for future research; and to have been consistent in the methods applied. The papers were grouped in function of the methods, purposes, and variables (see Figure 29.1). Subsequent encoding allowed discrimination between three types of analysis: descriptive, correlation, and predictive.

**Descriptive and correlation-based research**

The first papers in scientific journals presented a methodological design that was fundamentally based on a descriptive analysis of tactical and technical indicators. Although these types of studies were pioneering before 1985 (Cox, 1974; Baacke, 1982; Byra and Scott, 1983; Ejem, 1980; Ejem and Horak, 1980; Vojik, 1980), they are still conducted today because they positively contribute to a sound knowledge regarding the evolutionary trends of the game. These studies represent accumulated data in different game actions in function of their effect (e.g. number of points earned with the serve, percentage of errors in the attack). Currently, these analyses tend to be a starting point in each paper, after which different and more sophisticated analyses are
conducted. The most widely analysed performance indicators were related to the attack (Castro and Mesquita, 2010; Katsikadelli, 1995), followed by the set (Palao et al., 2004, 2005), serve (Agelonidis, 2004), defence (Mesquita et al., 2007), block (Palao et al., 2004), and reception (Palao et al., 2006). By presenting global measures of performance, these studies proposed to describe and characterize tactical and technical indicators related to performance (Hughes and Franks, 2004).

Jäger and Schöllhorn (2007) authored one of the main papers on the subject, focusing on the players’ movements and tactical manoeuvres. They identified specific tactical patterns by different women’s national teams, which were probably adapted to the individuality of the team members, and concluded that each team presented their own unique tactical patterns, with implications for the training processes. Approaches using pattern-recognition procedures, allowing analysis of player movements with clustering methods, have only recently had an impact in the specific literature.

Correlational studies followed the descriptive ones in an attempt to identify relationships between different sets of game actions (Katsikadelli, 1996). The major purpose was to understand the extent to which changes in performance in one game indicator would reflect upon performance in the subsequent actions. This line of investigation was predominantly correlational or associative in nature. A considerable body of research applied bivariate statistics (namely the chi-square), with a smaller percentage using sequential lag analysis.

This line of research has shown that volleyball actions exhibit a strong relationship, possibly due to their relative deterministic structure (Afonso and Mesquita, 2011), especially in space and type of action (Afonso et al., 2005a, 2005b; Castro and Mesquita, 2008; Costa et al., 2010). Some of the relationships found were: features of the opponent’s block (number of players, cohesiveness, starting positions) and attack efficacy (Mesquita and César, 2007); setting zone and type of set with attack efficacy (Afonso et al., 2010; Laios and Kountouris, 2010); and characteristics of reception and defence with attack efficacy (Costa et al., 2011). Mostly, research has focused on the study of the side-out phase, with few studies focusing on the transition phase. The side-out or complex I (KI) is the attack after serve-reception, consisting of serve-reception, setting, and attack. The transition or complex II (KII) is the counter-attack phase, comprising the block, defence, counter-attack setting, and counter-attack. Overall, these studies have demonstrated the high regularity and stability in defensive and offensive patterns and this should be considered when designing preparation processes for teams. Despite using different samples and variables, attack efficacy has repeatedly been shown to be independent with regard to previous game actions (Castro and Mesquita, 2008; Costa et al., 2010). The ability of the attacker, the tactical and technical quality of the opposing block, and even psychological factors may be stronger predictors of attack efficacy than the type of block of the opposition (Afonso and Mesquita, 2011).

A concurrent line of research was based on correlation analysis, and it searched for significant relationships between the efficacy of certain game actions and the final score, whether in the set (Marcelino and Mesquita, 2008; Marelic et al., 2004; Monteiro et al., 2009) or the match (Marcelino et al., 2008; Palao et al., 2004; Papadimitriou et al., 2004; Zetou and Tsigilis, 2007). Although these studies have provided limited information, since the relationships were bivariate, they have established that performance in attack and reception are highly related to success in volleyball (Marelic et al., 2004; Zetou and Tsigilis, 2007). The diversity of variables used in such studies makes generalization difficult, but the studies have suggested paths for future research.

Some studies have built models presenting performance indicators with discriminatory power concerning the final result (for example, ‘Best reception, first set attack’; Zetou and
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Tsigilis, 2007). Marcelino et al. (2008) have verified that the overall performance of the teams and the performance in each game action differ in function of using absolute data (e.g. number of spike points) or relative variables (e.g. percentage of spike points). Results show that the best teams present better performances in relative variables concerning the attack (coefficient of spike, percentage of spike points, and percentage of spike errors), the serve (percentage of serve points), and the block (percentage of block points). Therefore, it seems that relative variables present greater explanatory power of success than absolute variables.

**Predictive analysis of performance**

Research studies that have focused on the development of predictive models of performance, using multivariate statistics, are still scarce, especially in volleyball (Marcelino et al., 2011a). The additional value of these methods is related to the predictive potential to regulate training and match performance alike, but excessive speculation should be avoided, as warned by Heazlewood (2006: 541–2):

Mathematics and science are based on principles of description and more importantly prediction. The ability to make substantive and accurate predictions of future elite level sports performance indicates that such approaches reflect ‘good’ science. Often these predictions are purely speculative and are not based on any substantial evidence.

One of the first scientific works, if not the first, that focused on volleyball (Cox, 1973) analysed the relationship between team performance and the skill components of serving, serve reception, setting, spike, spike defence, and free-ball passing, as measured by adapted charting procedures. The spike was the most influential skill in predicting team success, followed by spike defence, serve reception, setting, serving, and free-ball passing. This trend was corroborated by other studies (Marcelino et al., 2008; Marelic et al., 2004; Zetou and Tsigilis, 2007).

Recently, relationships between performance indicators and the final outcome of the match have been established. Applying a logistic regression, Rocha and Barbanti (2006) concluded that it is possible to predict 77.7 per cent of the set outcomes in volleyball using only the number of attack errors and the teams’ performance in blocking and serving. In the same vein, João et al. (2010) identified gender differences in volleyball game-related statistics using a discriminant analysis. Considerable variability was evident in the game-related statistics profile, as men’s volleyball matches were more strongly associated with terminal actions (errors of service), while women’s volleyball matches were characterized by continuous actions (in defence and attack). This suggests an influence of the anthropometric and physiological differences between women and men on performance profiles.

Marcelino et al. (2009a) analysed 65,000 actions of the 2005 World League using logistic regression and demonstrated that victory within sets is significantly associated with performance in each of the game actions (serving, reception, setting, attack, defence, and blocking). Likewise, they concluded that playing at home increases the likelihood of winning each set, an advantage that is greater for the first, fourth, and fifth sets.

The comparison of performances between winning and losing teams has also been granted attention from research in order to find the most relevant performance indicators associated with success in volleyball (Drikos and Vagenas, 2011; Marelic et al., 2004; Rocha and Barbanti, 2006), mainly applying discriminant functions. Certain performance indicators have emerged as more powerful in explaining performance than others. Overall, attack effectiveness (Drikos and Vagenas, 2011), the spike in the attack phase (Marelic et al., 2004), as well as blocking
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performance, serve performance and attack errors performance (Rocha and Barbanti, 2006) have been demonstrated as largely influencing the final result.

Multivariate models capable of integrating the effects of different explanatory variables and their interactions on a target variable have recently been used in volleyball match analysis (Afonso et al., 2010) in order to understand how space, time, and task-related variables relate to match performance. The first papers published within this scope were authored by Eom and Schutz (1992a, 1992b). The aim of their first study (Eom and Schutz, 1992a) was to investigate playing characteristics of team performance in international men’s volleyball using discriminant analysis. Significant differences between team standing and game outcome were due to better performances in the game skills used in the counter-attack process. The block and the spike were the most important skills in determining team success. The aim of the second paper (Eom and Schutz, 1992b) was to develop and test a method to analyse and evaluate sequential skill performances in a team sport. Log-linear procedures were used to investigate the nature and degree of the relationship in the first-order (pass-to-set, set-to-spike) and second-order (pass-to-spike) transition plays. Results showed that there was a significant dependency in both the first-order and second-order transition plays, indicating that the outcome of a skill performance is highly influenced by the quality of a preceding skill performance. In addition, the pattern of transition plays was stable and consistent, regardless of the classification status: game outcome, team standing, or transition process. These studies represented a hallmark, a changing point, as they moved forward to more comprehensive and ecological models of performance, surpassing the simple counting of game actions and their efficacy.

More recently, studies using multinomial logistic regression have evidenced regularities in the team behaviours and presented relevant contributions for practice. Castro and Mesquita (2010) analysed factors that could predict the attack tempo in the complex II or transition phase of volleyball. The variables dig type, dig efficacy, and setting zone demonstrated predictive power of the attack tempo. An increasing dig efficacy and stabilization of dig type improved the quality of dig action and the setting action increased the use of quicker attack tempos. Following this trend, two studies have analysed tactical determinants of attack efficacy. Castro et al. (2011) and Costa et al. (2011) demonstrated that speed (attack tempo) and power (attack type) have a relevant impact in determining complex II attack success. However, quicker attacks increased the chances of scoring only in transition (Costa et al., 2011). Afonso and Mesquita (2011) wanted to further study this, so they analysed the probabilistic relationships that assisted in predicting outcomes relating to block cohesiveness and attack efficacy in elite-level women’s volleyball. Particular emphasis was placed on anticipation movements (Williams, 2009), as they are grounded on a well-timed extraction of relevant information (Bar, 2007). On many occasions, this mental anticipation translates into motor anticipation as the player and/or the team start moving ahead of the predicted stimulus. The authors concluded that the availability of the middle-player to run quick attacks was a key variable in inducing motor anticipation in the blockers. In fact, motor anticipation in blocking a quick attack successfully diminished the likelihood of opposition success in several types of quick attacks or combination plays.

Teams should be thought of as self-organized dynamic systems under pressure from external constraints, a tenet that has been leading research towards a new research pathway (McGarry et al., 2002). Some sports will most likely exhibit a lack of static game patterns (McGarry et al., 2002), but they should present probabilistic patterns from where the game will unfold (Walter et al., 2007). Notational analysis might be successful in highlighting the dynamic stability inherent in each team and/or game. Following these recommendations, recent research in the field of notational analysis is embracing the reality of non-linear interactions, highlighting the dynamic stability inherent to each team and/or game (Hale, 2001).
Based on these assumptions, more recent models of analysis tend to contemplate situational constraints as influencing game performance (Laios and Kountouris, 2010; Marcelino et al., 2011a). Among the analysed variables, venue (Marcelino et al., 2009a, 2009b), line-up (Laios and Kountouris, 2010), the level/quality of the opposition (Marcelino et al., 2010, 2011a) and the match status (Marcelino et al., 2011a) have been emphasized in volleyball. Research based on the quality of the opposition has demonstrated that it is difficult to proceed to a symmetric separation of groups of teams according to their ranking in the competition (Marcelino et al., 2011b; Taylor et al., 2008). Attempting to skirt this problem, it is proposed that the numeric difference between the rankings of the teams may be a more sensitive variable (Lago, 2009; Lago et al., 2010).

Match status represents the match score at the specific moment of the observation. It is hypothesized that game behaviours and their performance vary throughout the game and change according to temporary variations in the result (Mesquita and Marcelino, in press). In most studies, the categories for match status were defined a priori and contained a considerable amount of data. Usually, the adopted intervals were: losing \([-\infty; -1]\), tied \([0]\) and winning \([1; +\infty]\). This system, which is suitable for low-scoring team sports such as soccer and field hockey, appears limited for high-scoring sports such as handball, basketball, and volleyball. In these cases, the stipulated categories should differentiate losing and winning situations where the difference in the score is small or large. In volleyball, to our knowledge, only one paper was published so far that addressed this.

Marcelino et al. (2011a) examined the effects of quality of opposition and match status on technical and tactical performance in volleyball, as measured by block, attack, serve, and set actions related to the tasks, space, players, and efficacy of selected game actions (2007 Men’s World Cup). In an attempt to obtain a more reliable measure concerning the quality of opposition, teams were classified through cluster analysis as ‘high’, ‘intermediate’, or ‘low’ quality. The difference between points scored and points conceded was used to define match status. By and large, match status affected tactical performance indicators and this was influenced by the quality of the opposition, as had been previously identified (Lago, 2009). In contrast to these findings, technical variables were unaltered by situational variables, as previously reported in volleyball (Eom and Schutz, 1992a). Results further suggested that volleyball teams took more risky decisions in unbalanced situations. They also carried less risk through technical and tactical decisions in balanced and moderate situations whether they had the advantage or not. Therefore, strategic behaviour was affected by the interaction of quality of opposition and match status, providing a better understanding of volleyball game performance and new insights for practice, competition, and research.

**Beach volleyball performance analysis: methodological tools and technical and tactical indicators**

The online databases used to find the articles about performance analysis in beach volleyball were SportDiscus®, PubMed, Web of Science, Google Scholar, Sponet, and Dialnet. The key terms used in the search were ‘beach volleyball’, ‘game analysis’, ‘match analysis’, ‘notational analysis’, ‘performance analysis’, ‘performance indicators’, ‘technical analysis’, and ‘video analysis’. Only papers from peer-reviewed journals were considered in the search. An initial revision of the papers was done by analysing the title and abstracts of the papers. A total of 17 papers were selected (2003–2011). The papers were grouped according to methods, purposes, and variables. Subsequent encoding allowed for discrimination between three types of analysis: descriptive, correlation, and predictive.
**Descriptive and correlation analysis**

The first papers related to performance analysis in beach volleyball were focused on analysis of technique from a biomechanical perspective (manner of execution, reference values, and differences between the techniques used in indoor and beach volleyball – e.g. skills, jumping, landing, etc.). Specifically, in relation to technical and tactical analysis of beach volleyball, most of the studies have used a correlational analysis of the data. The differences found with the first stage of the development of indoor volleyball showed that, despite the later start, the studies done in beach volleyball present more complex analyses. However, it may be that the analysed articles are from peer-reviewed journals that only accept this type of analysis. These aspects can be viewed as positive (state of the research used to study PA in beach volleyball) and at the same time as negative (risk of absence of reference values in beach volleyball; descriptive stage of a problem).

With regard to the studies that do a correlational analysis, three lines of study can be seen after analysing the articles found: a) studies that analyse the relationship between game actions; b) studies that analyse game actions in different contexts; and c) studies that analyse game actions and outcome.

Concerning the relationships between game actions, the studies that were reviewed showed:

- A relationship between the way the serve is executed and its efficacy (Martinez-López and Palao, 2009). The technique used is significantly associated with serve efficacy (points and error), but not with rally outcome (Koch and Tilp, 2009a; Martinez-López and Palao, 2009). The type of serve execution with the greatest efficacy was the serve directed towards the zone of interference between receivers.
- No relationship was found between the set and attack (Koch and Tilp, 2009a).
- A relationship between reception and attack (type and efficacy) for males and female players (Lacerda and Mesquita, 2003). When the reception conditioned the attack, female players tended to execute a hard attack (more effective options), and when the reception was perfect, more variability in the attack type was found (Koch and Tilp, 2009a).
- A relationship between the way the attack was executed and its efficacy, the opposition block, and the chances to win the rally (Martinez-López and Palao, 2010; Mesquita et al., 2003; Mesquita and Teixeira, 2004a, 2004b). The zone of execution (origin and ending) affects the attack effectiveness. For males, the most used and most effective technique is the power spike. There are significant associations between the previous action and the type of attack with its quality (higher reception efficacy, higher attack efficacy), as well as between the block opposition and attack effectiveness (type of attack used). For female players, similar effectiveness using different types of attack was found. Significant associations between ranking and game outcome and type of attack were also found. The spike had its greatest efficacy when it was directed to lateral and deep zones of the court.

With regard to the studies that analyse game actions in different contexts, two groups of studies can be differentiated: a) studies about the rule changes made by the FIVB; and b) studies about the differences between the ways in which the two sexes play. Several studies have been done on how the rule changes made by FIVB in 2000 have affected game performance. The rule changes made by the FIVB involved a reduction of the court surface (9 × 9m to 8 × 8m), a change in the score point system (side-out system to rally point), and the serve is now allowed to touch the net. The goal of the changes was to make the game more understandable for the
public, increase the continuity in the game (duration of the rallies) and standardize the match duration. Besides these generic goals, several studies have been done to analyse the effect of these changes in the rules on the way in which the game is played. Giatsis and Tzetzis (2003) studied the reception and attack in the men’s Hellenics Championship. They did not find differences in attack efficacy before and after the rule changes, despite the court reduction. The authors justified these results because they also found an increase in the reception efficacy, which allowed the players to do the attack under better conditions and because teams are using different types of offensive tactics. Ronglan and Grydeland (2006) also studied the effect of the rule changes on the serve, reception, set, attack, block, and defence efficiency by analysing matches of the men’s FIVB World Tour. The researchers found a significant reduction in serve points (4 per cent), serve errors (3 per cent), and attack points (6 per cent), and a significant increase in block actions and block points (4 per cent). No significant differences were found in defensive actions (frequency or efficiency). Investigations about rule changes that studied the relationship between game actions using a correlational analysis do not allow us to establish whether the change in the score system and court dimension has increased the continuity of the game – one of the FIVB’s intentions.

Yiannis (2008) briefly compared the technique and efficacy of the different skills performed by male and female players in the 2004 Olympic Games. The results of this study revealed differences between the way the game is played by men and women (e.g. use of power jump serve, hard attack, etc.). Koch and Tilp (2009b) also studied these differences in the way that males and females play in matches from the FIVB World Tour competition. Their results also indicated that top male and female players apply different techniques for success. Differences were found in the technique and quality of serve (men use more jump serves and women use more float serves); in the technique of the reception (men use the lateral reception more than women), set (women use the forearm pass more than men), block (men use the active block more and women use the fake block more), and defence (women defend more shots and men defend more spikes); and in technique and quality of attack (men use the cross-court spike more than women and men make more points and errors than women).

In relation to the studies that analysed game actions and outcome (match, set, or team classification) in the Hellenic Championship, Giatsis and Tzetzis (2003) found that the changes in the court size and the scoring system affected the performance of skills that contributed to winning the match. Before the changes, the skill that was most correlated with winning was the quality of the reception and, after the changes, the winners were the ones that had better attack efficiency and fewer errors (especially in the serve and set). Also in the Hellenic Championship, Michalopoulou et al. (2005) found that the winning team had a higher efficacy in the serve and the attack than the losing team. No differences were found in the reception, set, block or defence.

**Predictive analysis of performance**

In the review that was carried out, only two studies were found that used predictive modelling to study performance. This type of analysis allows for establishing models of performance and relationships between several variables or aspects of the game. The first study was done by Grgantov et al. (2005). They studied the impact of the different skills on game outcome in relation to winning or losing after and before the rule changes in the men’s Croatian Championship. The results showed that the rule changes have modified the structure of performance. Before the changes, the side-out attack was the most influential skill in predicting the team’s success; followed in order by serve reception, court defence, block, counter-attack, and serve. After the changes, the side-out attack was still the most influential skill in predicting the team’s
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success; followed in order by block, counter-attack, court defence, and serve. The attack was the action with the highest predictive power for obtaining a victory with the block and counter-attack. The importance of the serve reception was reduced, according to this study. These results are different from some of the previous studies analysed that used a bivariate analysis. Now the skills that contribute more to winning the match are the ones done above the net (side-out attack, counter-attack, and block). The reasoning for the reduction in the importance of serve reception could be the combination of the reduction in the court size and the fact that an error in the serve gives a point to the opponent.

The second study was done by Giatis and Panagiotis (2008). They studied the importance of the serve, attack, block, and dig skills on game outcome in relation to winning or losing and the type of match (two or three sets) in the FIVB men’s World Tour. They used a discriminant analysis to determine which skill(s) contributed significantly to winning two-set and three-set matches. They found that in 2–0 matches, the winners had better performances than the losers in almost all technical skills. Six parameters discriminated between winners and losers in matches with a 2–0 score: error in attacks, other errors, aces, counter-attacks, kills, and blocks. Opponents’ attack errors were the most important factor contributing to a team winning. In 2–1 matches, it was not possible to establish a model that would indicate that a technical skill could act as a predictor of the winning team in a match.

The differences found between these studies are probably due to the difference in the levels of the samples studied (national championship vs. World Tour). It is possible that in the national championship the differences between players are larger than at the international level. In fact, if this theory is true, when teams are closer in skill level, it is more difficult to find differences between winning and losing teams. Another possible difference is that the two studies did not analyse the same variables. Grgantov and collaborators studied all the skills (serve, reception, set, attack, block, and dig), while Giatis and Panagiotis studied four skills (serve, attack, block, and dig). From the review done of the articles available, it appears that the study of performance has started in beach volleyball, but more studies are required to establish patterns, structure, and tendencies.

Trends and future tendencies in volleyball and beach volleyball performance analysis

Chronologic analysis of PA in indoor volleyball has evidenced the evolution of predominantly descriptive studies towards more complex, multivariate analyses attempting to predict performance. Initially, players’ and teams’ behaviours were analysed as finished, static products, as if they were fingerprints of the sport. This was done regardless of the nature of the opposition and of the moment of the match in which they were expressed. Traditionally, research was conducted through the accumulation of data concerning efficacy of performance.

The search for linear relationships between variables assumed simple and reductionist connections, reducing ecological validity, in face of the complex and changeable nature of team sports. One of the most important limitations was the neglect of the sequential aspect of the game and its situational specificity (Lames and McGarry, 2007).

More recently, there has been a change in emphasis towards more predictive analyses, with the purpose of modelling performance in volleyball. This was based on the recognition that team sports obey the principles of complex systems (Bar-Yam, 2003; García-Manso et al., 2010; Noakes et al., 2004; Volossovitch, 2008) and now represents a strong line of research in PA in volleyball. Complex systems are understood as ‘complex structures that consist of several elements, usually numerous, whose relationships are nonlinear’ (García-Manso et al., 2010: 14). García-
Manso et al. argued that a relationship is not linear when the response is not proportional to the impulse, or the outcome is not equal to the input. The authors added that non-linearity means that there may be more than one answer to the same stimulus and that in many cases the answer is not at all predictable. They concluded that ‘a non-linear world certainties disappear and move onto probable’ (García-Manso et al., 2010: 14). Including the assumptions of complex systems’ analysis in the study of team sports has found several limitations when actually designing the methodological approaches. More often than not, there is a simplification of the teams’ behaviours, resulting in an effort of methodological sophistication more than in producing relevant knowledge (Morin, 2007).

The broad use of computer technologies in sports and the utilization of advanced mathematical models still defy research in PA in volleyball. The challenge is to provide interactive data that keep the original sense of the game. Therefore, proper video sequences must be obtained, and robust and consistent coding processes should be collected over time with consideration of multiple interactions.

The reality of beach volleyball is completely different. Beach volleyball is still taking its first steps regarding the study of performance. This line of research has been carried out for less than ten years. The path taken and reference provided by indoor volleyball acts as a guide in establishing the next steps in the study of PA in beach volleyball. From the review carried out, future trends in the study of beach volleyball involve studying women’s beach volleyball, increasing the variables studied, and combining descriptive, correlational, and predictive analyses in order to obtain reference values and game patterns.

Concluding remarks
An overview clearly highlights that the improvement of volleyball performance has been accomplished by knowledge of match regularities, reinforcing the role of notational analysis in the understanding of match constraints and in guiding practice.

This chapter described research trends within the scope of PA in volleyball. A parallel between the evolution of research and the development of more sophisticated methodological designs was evident, both attempting to grasp the complex and dynamic nature of the game.

In indoor volleyball, the path covered by research has attempted to identify and quantify patterns in the teams’ tactical and technical performance, considering the interaction between sets of game actions and their relation with the competitive success. More recently, contextual factors have been considered in their contribution for performance outcomes. In beach volleyball, there is still a lot of work to do to establish reference values and game patterns, instruments of analysis, and aspects that affect performance. However, the structural similarities between the two sports allow us to apply similar methods to some of the problems of indoor volleyball and beach volleyball. The highly deterministic nature of volleyball action sequences has facilitated the construction of predictive models of performance, and future research should provide a more thorough approach to this purpose.

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