



# Performance differences between winning and losing under-19, under-21 and senior teams in men's beach volleyball

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## ABSTRACT

This study aimed to compare beach volleyball performance indicators between winning and losing teams in different age groups. Game actions from the 2010 to 2011 Men's World Championships were observed using video match analysis (6095 from under-19, 5138 from under-21 and 8705 from senior matches). Variables assessed were: number of points won in each complex of the game, number of points and errors by game action (serve, attack in side-out, attack in counterattack, block and other errors); and performance coefficient of game actions (serve, reception, set in side-out, set in counterattack, attack in side-out, attack in counterattack, block and dig). Practical significance of data was analysed using magnitude-based inferences. Results have showed similar patterns in the three age groups. There were differences in the game profile according to the game result and age group. Winning teams scored more points in counterattack: points from the opponent's attack errors, counterattack points, block points and points from other errors. The article provides new insights to beach volleyball coaches and performance analysts, emphasising the need to consider the interaction between different performance indicators, both in training process and match analysis in beach volleyball.

## ARTICLE HISTORY

Received 29 August 2016  
Accepted 28 February 2017

## KEYWORDS

Sport; performance; match analysis; age groups

## 1. Introduction

Match analysis in team sports, such as beach volleyball (BV), can contribute to a better knowledge of the game and to understand its key factors (McGarry, 2009). A critical feature assessing performance it is the way in which technical and tactical actions are measured (Hughes & Franks, 2004). The use of different metrics, type of analysis, game actions and phases can provided different perspectives of the game (Mesquita, Palao, Marcelino, & Afonso, 2013; Rodriguez-Ruiz et al., 2011). For example, if we only considered the way

points are scored, the representation of the performance indicators can be compromised (Hughes & Franks, 2004), just by analysing only the actions that allow us to get points. The analysis of the game must consider nonlinear interactions taking into account the specificity of game phases (Mesquita et al., 2013; Thelen, 2005), instead of establishing simple cause-and-effect relationships. In BV, not all game actions have the same impact on the game outcome. Whereas terminal actions (serve, attack and block) allow scoring points directly, the continuity actions (dig, set and reception) generate continuity of play, preventing the opponent from scoring while creating the best option to score (Coleman, 2002). These game actions can be grouped into different game phases of three actions (team's possessions), called complexes (KI, KII, KIII and KIV) (Palao, Santos, & Ureña, 2004). The analysis of the game complexes enables a deeper and contextualised understanding of the performance indicators that distinguish between the winning and the losing teams. For a proper insight of game dynamics, these performance indicators must be studied at different levels and age groups (Lorenzo, Gómez, Ortega, Ibáñez, & Sampaio, 2010). The current knowledge about the influence of the performance capabilities (anthropometric, physical and psychological) between young players and senior players is well known and these players might use different strategies and tactics to win games (Gerodimos, Manou, Kellis, & Kellis, 2005; Harley et al., 2010). However, information is currently only available about senior players (Giatsis & Panagiotis, 2008; Giatsis & Tzetzis, 2003; Michalopoulou, Papadimitriou, Lignos, Taxildaris, & Antoniou, 2005).

Research related to tactical performance has been conducted mostly with senior players, both in indoor volleyball (e.g. Afonso & Mesquita, 2011; Drikos & Vagenas, 2011) and BV (Giatsis & Panagiotis, 2008; Giatsis & Tzetzis, 2003; Michalopoulou et al., 2005). In senior players, the studies concluded that the actions that best predict the game or set success in senior male BV teams were the attack (points and opponent errors) and serve. Data from indoor volleyball show that male senior players have a high performance on reception and attack efficacy compared to younger players (García-Alcaraz, Ortega, & Palao, 2015; García-Alcaraz, Palao, & Ortega, 2014). However, due to the fact that BV has only two players per team, a smaller court and a different surface and some of the rules are different, direct inference from one game to the other is not possible. Regarding game phases, studies in indoor volleyball show different efficacies between the complexes but also displaying dependency of the teams' game level. Senior categories have shown a greater efficacy in K1 (65%) when compared with K2 (35%) whereas in younger categories (U-19), the performance of these phases was similar (K1 66.1%; KII 33.9%) (Costa, Afonso, Brant, & Mesquita, 2012). However, there is little match analysis focused on K3 and K4 in volleyball, both indoor and BV (Castro, Souza, & Mesquita, 2011; Zetou, Moustakidis, Tsigilis, & Komninakidou, 2007). Hence, to properly understand the game, the information about different actions and game phases must be included when team performance is analysed.

Further, to win a beach volleyball match, it is necessary to win two sets; in other words, a team must win two microgames. Thus, each independent set can determine the performance of a team tactically (Jäger & Wolfgang, 2007), psychologically (Males, Kerr, Thatcher, & Bellew, 2006) and physiologically (Sheppard, Gabbett, & Stanganelli, 2009). Therefore, the analysis of the performance must consider the incidence of individual actions and the collective phases in the game results. A better knowledge of how these aspects evolve from younger to senior teams will help to understand the aspects that influence match success and its evolution through players' development process in BV. This information can help

the comprehension of game dynamics, guide training programmes and objectives in competitions throughout the athlete's long-term development. The purpose of the present study was to compare the beach volleyball performance indicators between winning and losing teams in different age groups (U19, U21 and senior).

## 2. Methods

### 2.1. Sample and variables

The sample comprised 30 sets (1100 serves, 786 attacks in side-out, 404 attacks in counter-attack, 807 blocks, 900 receptions, 1170 sets in side-out, 350 sets in counterattack and 578 digs) of U19, executed by 32 players; 24 sets (927 serves, 714 attacks in side-out, 316 attacks in counterattack, 722 blocks, 784 receptions, 975 sets in side-out, 255 sets in counterattack and 445 digs) of U21, executed by 30 players; and 42 sets (1564 serves, 1289 attacks in side-out, 588 attacks in counterattack, 1296 blocks, 1370 receptions, 1282 sets in side-out, 463 sets in counterattack and 853 digs) executed by 46 senior players. Actions were collected from the 2010 World Championships (U19 and U21) and the 2011 Men's World Championships (senior). All competitions were organised by FIVB (Fédération Internationale de Volleyball). The study was approved by the Ethics Committee of the Centre of Research, Education, Innovation and Intervention in Sport at the University of Porto, Portugal.

The variables are part of the observation instrument (Manual for Observation Instrument of Techniques and Efficacy in Beach Volleyball – TEBEVOL for its acronym in Spanish) designed and validated by Palao and Manzanera (2009) and Palao, López, and Ortega (2015). Variables assessed were the following: total number of points won by game phase (K1, K2, K3 and K4); total number of points and errors by game action (serve, attack in side-out (K1), attack in counterattack (K2 + K3 + K4), block and other errors) and performance coefficient of game actions proposed by Coleman, Neville, and Gordon (1969) (serve, attack in side-out (K1), attack in counterattack (K2 + K3 + K4), block, reception, set in side-out (K1), set in counterattack (K2 + K3 + K4) and dig). The K1 is defined as the game phase when the team that receives the serve performs the actions of reception, set and attack in a sequential order, while the K2 game phase describes the situation when the opposing team performs the sequential actions of the serve, block, dig, set in the counterattack and counterattack (Zetou, Tsigilis, Moustakidis, & Komninakidou, 2006; Zetou et al., 2007). The K3 and K4 game phases are designated to all subsequent plays, depending on whether the team started the rally in K1 or in K2, respectively (Palao, 2004).

The serve, attack and block were evaluated with a five-level scale to categorise the performance: error (0), maximum opponent attack options (1), opponent limited attack options or team limited attack options (2), no opponent attack options (3) and points (5). The reception, set and dig were evaluated with a scale of four levels to categorise the performance: error (0), no attack options (1), limited attack options (2) and maximum team attack options (3). The performance coefficient for each action was calculated as the sum of the intents from each category multiplied by the value of each category and divided by the total number of intents (Coleman et al., 1969). Only actions from the first and second sets were observed. The third set was not assessed since the number of points and rallies was significantly smaller than in the previous sets. This is a consequence of game rules, namely the number of points needed to win a set (Federation Internationale de Volleyball, 2012).

## 2.2. Procedures

Sets were recorded using a digital video camera, which was positioned in the grandstand at approximately 10-metre distance from the baseline, for a full-court frontal view. To guarantee observation reliability, intra- and inter-observer agreements were assessed through the use of the percentage error method (Hughes, Cooper, & Nevill, 2004; James, Taylor, & Stanley, 2007). After a three-week period of original observations, the observer reanalysed 14 random sets (14.9% of the total analysed sets) to prevent any learning effect. Aiming inter-observer reliability testing, another observer analysed 12 random sets (12.7% of the total analysed sets) that had previously been analysed by the original observer. The reliability values obtained were < 5% of errors and considered acceptable for all recorded variables. Observations were carried out by an observer who was trained during three sessions of two hours each, following Anguera's (2003) criteria for three two-hour sessions. The observer held a Master's degree in high performance training with specialisation in BV and had been a BV coach for 10 years in the elite level.

## 2.3. Statistical Analyses

Data practical significance were analysed using magnitude-based inferences (Cumming, 2013; Hopkins, Marshall, Batterham, & Hanin, 2009). This qualitative approach was used, as traditional statistical approaches do not often indicate the magnitude of the effect, which is typically more relevant to athletic performance than any statistically significant effect (Buchheit & Mendez-Villanueva, 2013). The standardised mean difference (SMD) or Cohen's *d*, computed with pooled variance and respective 95% confidence intervals (95% CI) (Cohen, 1988) was used to evaluate the differences between winning and losing teams in i) points by phase of the game, ii) total of points and errors and iii) team performance coefficients. Threshold values for Cohen's *d* statistics were 0-0, 2 trivial, >0, 2-0, 6 small, >0, 6-1, 2 moderate, >1, 2-2, 0 large and >2, 0 very large. If the 95% CI overlapped small positive and negative values, the magnitude would be deemed to be the observed magnitude (Hopkins et al., 2009). All statistical computations were performed in RStudio (version 0.98.977) using the *compute.es* (version 0, 2-3) package (Cooper, Hedges, & Valentine, 2009).

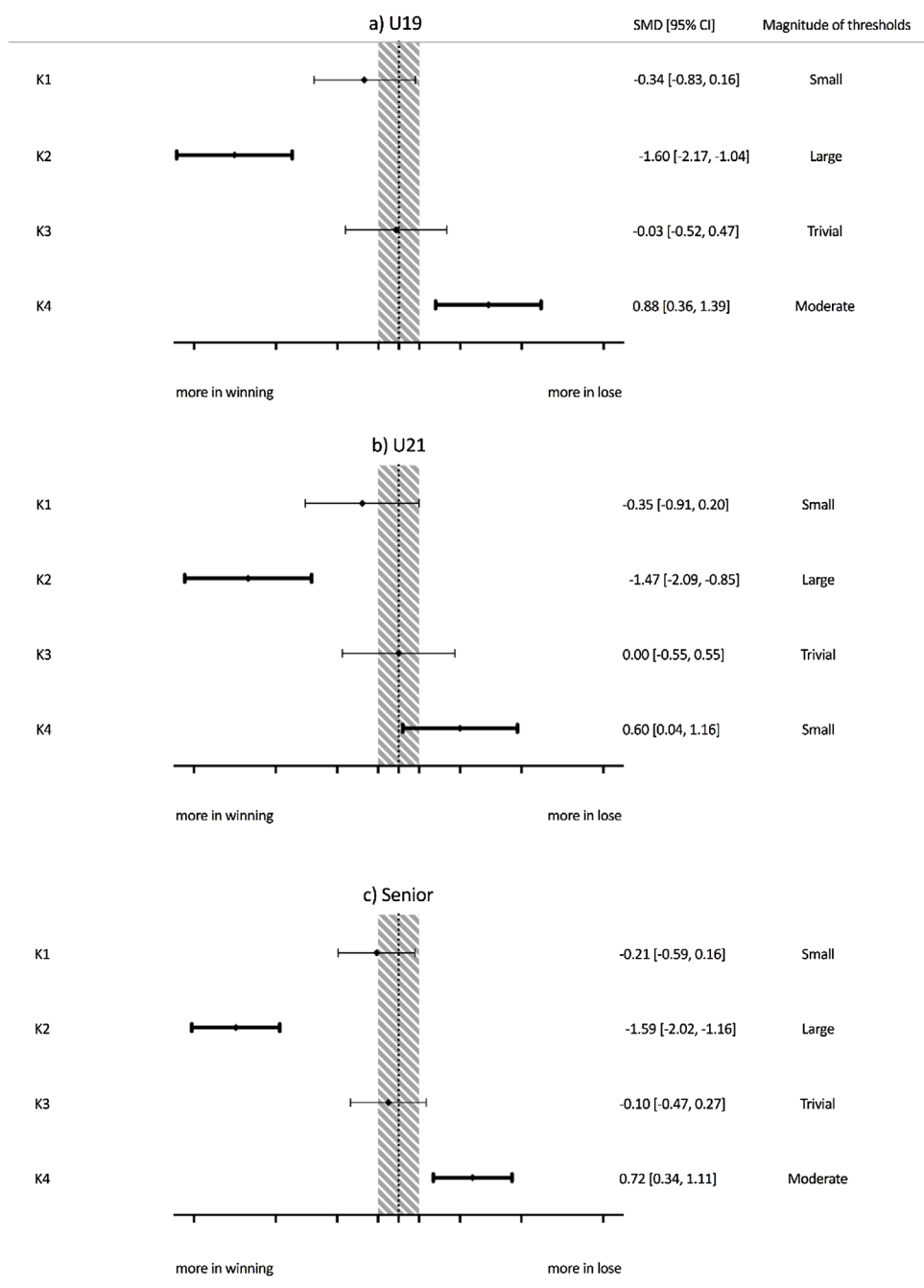
## 3. Results

Table 1 presents the descriptive analysis (mean  $\pm$  standard deviation and percentages) of the total number of points won in the game phases, total number of points and errors, and team performance coefficients, according to the result of the set (winning vs. losing).

Performance in K1 and K3 was the same for the teams (U19, U21 and senior) that won and lost their sets. Teams that won performed better in K2 (with large differences compared with losing teams) but worse in K4 (Figure 1(a)–(c)).

In all categories, the teams that won the sets obtained more points by serve, attack (K2, K3 and K4) and by block compared to the losing teams (Figure 2(a)–(c)). On the whole, the U19 and senior winning set teams made more errors in side-out attack (Figure 2(a), (c)) and in senior the winning teams obtained more points due to the opponent's other errors (Figure 2(c)).

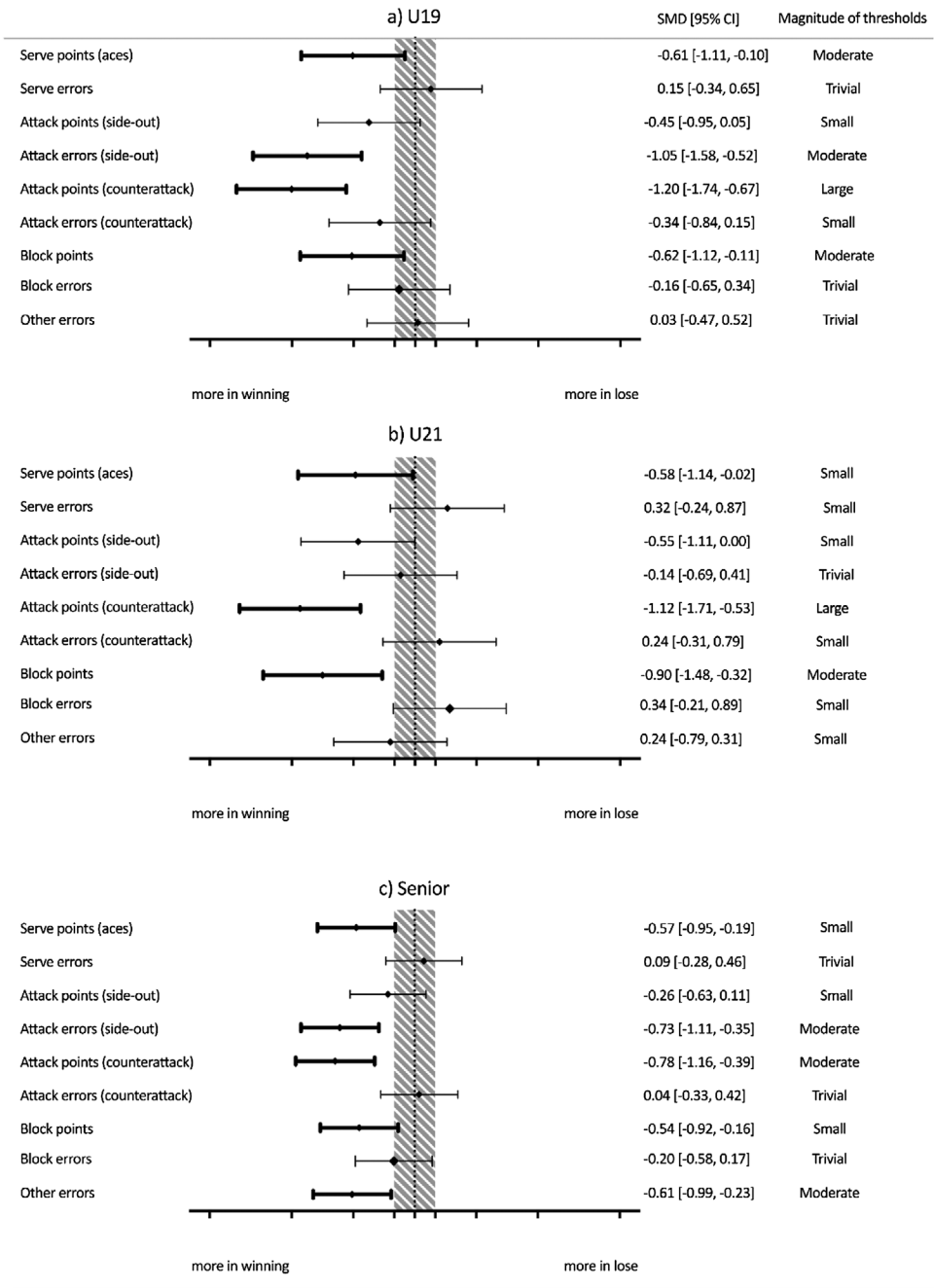




**Figure 1.** Standardised mean difference assessing the number of points obtained in team game phases in relation to the result of the set (winning vs. losing).

Note: The shaded area represents the smallest (trivial differences) worthwhile change (see “Methods”).

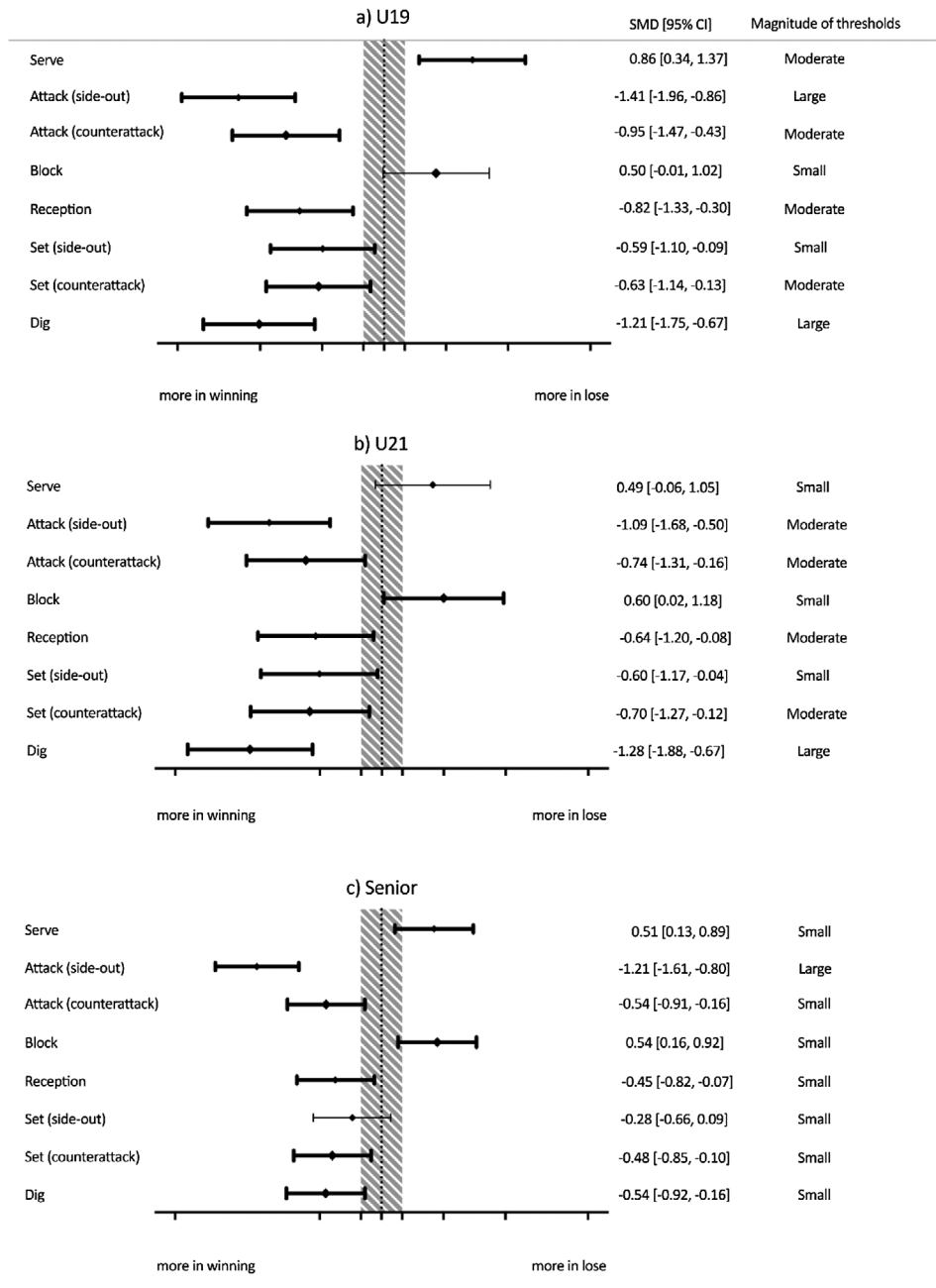
When comparing the performance coefficient of game actions between winning and losing teams (Figure 3), results have showed higher values for the winning teams in most of the game actions, with the exception of performance coefficient of serve and block. In



**Figure 2.** Standardised mean difference assessing teams' total number of points and errors in relation to the result of the set (winning vs. losing).

Note: The shaded area represents the smallest (trivial differences) worthwhile change (see "Methods").

these game actions, the losing teams have demonstrated small (U19: block; U21: serve and block; senior: serve and block) to moderate (U19: serve) differences in the performance coefficient, with winning teams presenting higher values.



**Figure 3.** Standardised mean difference assessing team performance coefficients in relation to the result of the set (winning vs. losing).

Note: The shaded area represents the smallest (trivial differences) worthwhile change (see "Methods").

#### 4. Discussion

The study aimed to compare BV performance indicators according to the final set result (i.e. winning vs. losing the set) in different age groups (U19, U21 and Senior). Variables



combined performance indicators regarding the game phases, the way points were obtained and performance coefficients of game actions in order to provide a broad perspective of how sets were won by male BV teams. These indicators have emerged from research of volleyball match analysis, providing more meaningful information about team performance in competition (Marcelino, Mesquita, & Afonso, 2008; Palao, 2004).

Among the three age groups, the K2 game phase differentiates winning and losing teams. Although there is a reduction in the points obtained by the winners in this phase as you go up the age groups, these points are those that make the teams win or lose the set. Winning teams achieved more points in this phase due to more serve points (aces), points from opponent's attack errors (though not in U21), counterattack points, block points and points from other errors (only in seniors). These results differ from previous findings in indoor volleyball, since the side-out phase (K1) was the best predictor to win the set due to the better efficacy achieved by teams that won the set in this game phase (Costa et al., 2012; Palao, 2004, 2008). These differences may be explained differently in calculating the efficacy. Whereas in the studies of Costa et al. (2012) and Palao (2004, 2008), the efficacy was calculated using a percentage, our study considered the contribution of each phase on winning the set as well as where and how the points were obtained. Thus, this study presents winning teams that had better performance in side-out by obtaining similar points in fewer attempts. The analysis of the contribution of each phase to winning and losing the set can be misinterpreted if we consider only the efficacy of each phase (Palao, 2008), since this approach does not allow us to know how points were obtained in each phase or their contribution to the set result or to the final match outcome.

Regarding the game phase, data also show that losing teams achieved more points in K4. Therefore, the losing teams on defence win more rallies than the winning teams, when rallies are long, likely by pushing harder and trying to recover the adverse scoring situation. However, due to the low number of points obtained in this game phase, its incidence in the game is reduced (approximately 1.5 points). On the other hand, 85–90% of the points were obtained through the side-out and counterattack phases.

The higher the category or age group, the lower the influence of the performance indicators on the game efficacy is. Nevertheless, in senior category, the effect size of the performance indicators between winners and losers was small. Several factors can cause these differences, such as years of experience and styles of play (Gabbett & Georgieff, 2007; Sheppard, Nolan, & Newton, 2012; Zapartidis, Vareltsis, Gouvali, & Kororos, 2009). Moreover, high-level players have the ability to execute several types of actions presenting an adaptable performance and a self-organised behaviour (Davids, Araujo, Correia, & Vilar, 2013). Thus, at the highest level, players adjust their behaviours to functionally adapt to teammates and opponents. This process enables them to act synergistically, linking self-organising behaviour, based on individual roles, within a team's organisation (Passos, Araujo, & Davids, 2013). Nonetheless, further studies are needed to identify other possible reasons for such a reduction at the senior level between winners and losers, taking into account other aspects that affect performance (e.g. the game strategy of each team; players' technical, tactical, physical and psychological features; team performance according to different situational constraints, such as match status, quality of opposition.).

Hughes and Franks (2004) emphasised the need to collect a wide range of information related to team performance, which allows us to have a broad game perspective. In all age

groups of the present study, a large quantity of performance indicators (fifteen) has been found differentiating winning and losing teams. Some of these performance indicators are positive and some negative. The positive performance indicators (such as points obtained in K2 phase, number of points obtained through the serve, attack in counterattack and block, and performance coefficients of serve, attack in side-out, attack in counterattack, block, reception, set in side-out, set in counterattack and dig) showed where the winning teams performed better and how they scored points. On the other hand, negative performance indicators displayed information about winning and losing teams' behaviours during the game. Although losing teams present better performance coefficients in the serve and block (balance between errors and points), winning teams achieved a higher number of points in those game actions. Therefore, the better performance in these two game actions is the result of the lower level of risk assumed by the losing teams (Marcelino, Sampaio, & Mesquita, 2012). Our findings reinforce the need to consider the interaction between different performance indicators in team sports (individual and collective actions) to achieve more in depth and fruitful information about teams and players' performance (Hughes & Bartlett, 2002). In BV as in other net and wall games, if we only use efficacy percentages to evaluate team game actions, it is possible to attain a proper perspective of the game as it does not provide information about how points were obtained or lost (game phase and actions). This data is necessary to provide more precise information in sport performance related to the needs of training process (Marcelino, Mesquita, Sampaio, & Moraes, 2010). Moreover, in BV the sets are played until a certain number of points (e.g. 21 points) which makes it possible to analyse data from different games without standardising the values. This helps to provide information closer to data used by coaches on their game analysis.

## 5. Conclusion

In summary, the interaction between the number of points obtained in each game phase, number of points and errors, and performance coefficient of game actions, helps to establish the difference between winning and losing teams in these levels of competition (international men's BV). Therefore, the results of the present study may add coaches and performance analysts new knowledge, emphasising the need for a holistic or adequate understanding of game dynamics. From a practical point of view, coaches can use this information to establish goals for players and teams in practices and matches at each age level. These goals can be set in a positive way (achievable goals, such as the number of points to score through the different actions), taking into account the interaction between the different performance indicators.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by CAPES (Brazil), Doctoral Grants Program [grant number BEX 0688/12-6/2012-2014].

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