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Olympic games: determinants of final ranking factors in men's and women's beach volley teams

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Abstract

The purpose of the current study was to find which performance indicators are more consequential in determining the final ranking of beach volleyball teams participating in the Olympics and to establish their appropriate cutoff values that can be considered as criteria that differentiate high-rank from low-rank teams. Analysis focused on the 144 teams that participated in the Athens 2004, Beijing 2008 and London 2012 Olympics. The ranking of a beach volleyball team was significantly dependent on two performance indicators: the proportion of successful attacks and the number of successful blocks. A team, both in men and women, meeting both criteria according to the computed cutoff values, will almost invariably pass successfully the preliminary round to the playoffs.

Keywords: Olympic Games; Beach volley; Performance indicators.

1 Introduction

Beach volley (BV) made its first appearance at the Summer Olympic Games in the 1992 Olympics in Barcelona as a demonstration event. One year later the International Olympic Committee officially acknowledged BV as an Olympic Sport and was included in the 1996 Atlanta Olympics.

In 2001 the Fédération Internationale de Volleyball (FIVB) introduced a number of new rules both for indoor Volleyball and for BV (FIVB, 2003), the most notable being the change from a superseded sideout system to a rally point system. According to the new rules each rally that starts with a serve yields a point and the team that wins the point will serve for the next rally. A game is won by the team that first wins two sets. The first two sets are played to 21 points with a minimum difference between the two teams of two points, otherwise the set continues until this requirement is met. If each team wins a set then they play a third set up to 15 points, again with the condition that the minimum difference between the two teams must be two points. During the first two sets every time the sum of the teams' points is a multiple of seven the teams change sides. The same happens in the third set at each multiple of five points. One additional change for BV was the reduction in the court dimensions from 9 x 9m (HC9x9) to 8 x 8m (HC8x8). A number of studies addressed the effect of these rule changes on team performance (Giatsis & Terzis, 2003; Giatsis et al., 2003) and the game duration (Giatsis et al., 2005).

The games at the Olympics starting from the Athens 2004 Olympics through the Beijing 2008 Olympics and the London 2012 Olympics were played according to the above rules. Furthermore, in both the men's and the women's tournaments there were initially 24 teams that were split into six pools of four teams each. In Athens the top two teams from each pool and the four best third placed teams progressed through to a single-elimination

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tournament of sixteen teams. The qualifying added a continental quota - in the event of an unrepresented continent, the top team from that continent earned a spot. In Beijing and London, the qualifying for third-placed teams was changed. Of the six 3rd place teams, two were directly qualified to the playoffs. Of the four remaining third placed teams, another two teams qualified to the playoffs from two lucky loser matches.

The Olympic gold medal is undoubtedly the most prestigious honor for any sport and it is the aspiration of every athlete. In international BV there are also the World Championships and the World Tour of the International Volleyball Federation (FIVB) for men and women, which in effect are more difficult, at least in the preliminary rounds than the corresponding preliminary round in the Olympics. This is apparent in many sports and the reason for this can be made clear by FIVB's announcement for the Rio 2016 Olympic Qualification System for beach volleyball, which, among other, states that: "The qualified places through the Olympic Ranking have also been decreased to fifteen per gender for this Olympic cycle. The changes have been made to allow lower-ranked countries a new route to the Olympic Games, offering them more experience and helping to develop the game around the world. As before, this also includes a maximum of two places per country." (FIVB, 2014). The authors are in total agreement with FIVB's reasoning.

The characteristic composition of the 24 teams provides a perfect opportunity to elucidate the performance indicators that segregate the top from the lower-ranked teams. More specific, the purpose of the current study was to find which performance indicators are more consequential in determining the final ranking of beach volleyball teams participating in the Olympics and to establish their appropriate cutoff values that can be considered as criteria that differentiate high-rank from low-rank teams. This will provide valuable information to the BV community, especially to national federations, coaches and players of lower-ranked countries as it will pinpoint the specific skills and tactics that need to be improved.

2 Method

2.1 Sample

The study focused on the last three Olympics, Athens 2004, Beijing 2008 and London 2012. The reason for this was explained above, since in all these tournaments the BV games were played with the same rules. Therefore, the sample consisted of 3 Olympics 2 genders X 24 teams yielding a total of 144 couples. Each team was characterized by its final ranking. Subsequently the rankings were recoded into a new dichotomous variable of rank group (RG), which included low-rank and high-rank teams. Each team was characterized as high-rank if it qualified through the first round to the final 16 teams or low-rank if it did not qualify to the elimination round. Thus, in total there were 96 high-rank and 48 low-rank teams.

2.2 Procedure

The performance indicators that were studied were the following: the attack success proportion (ASP) which is the number of successful attacks, i.e. attacks that immediately give the point to the attacking team to the total number of attacks, the serve aces proportion (SAP) which is the ratio of serve aces to the total number of serves, the serve faults proportion (SFP) which is the ration of faulty serves to the total number of serves, the number of successful blocks per game (BPG) and the number of digs per game (DPG). The first three proportions can also be expressed in their percentage form. These performance indicators were checked for their variability between the three Olympics, the two genders and the RG binary variable, as explained above.

One other indicator was also calculated: the number of opponent errors per game (OEPG) but as this indicator does not reflect the performance of the team it was not entered into the prediction models. The BPG, DPG and OEPG indicators are obviously dependent on whether the game ended in two or three sets. In order to be comparable, only the first two sets were taken into consideration for these variables.

All the data were collected from the official statistical bulletins of all Olympic tournaments both for men and women. At the same time all games were analysed with the VirtualDub software (VirtualDub, 2007). Since the primary interest in the study was the relationship between the performance indicators and the ranking of the teams, all the data from all games for each team in each Olympic tournament were added together, thus yielding the overall performance indicators that characterize each team. Overall 26780 rallies were analysed. The only performance indicator that is not associated with a scoring action i.e., an action that results in an immediate point for either team is DPG. Analysis found only two teams with one dig more than the number given in the official spreadsheets. With regards to scoring actions the discrepancy amounted to only one successful block. This shows that the official statistical bulletins are quite reliable.

2.3 Statistical analysis

Independently for each gender the ranking was entered into a stepwise linear regression model as the dependent variable with the five performance indicators as the independent predictors.

Receiver operating characteristics (ROC) analysis was performed to test the ability of the performance indicators to discriminate the high-rank from the low rank teams. Using the above results for the performance indicators that yielded significant discrimination ability the best cutoff values were determined by using the best tradeoff between sensitivity and specificity. Finally, using the combination of the cutoff values a set of simple criteria were created for the low-rank and high rank teams.

3 Results

Preliminary multivariate analysis of all the dependent variables (ASP, SAP, SFP, BPG and DPG) proved that there was no significant variability between the Olympics. Therefore this factor can be omitted from further analyses, which, due to the increased sample size, will yield more robust results. Multivariate analysis of the dependent variables proved that both gender (η^2=0.411, $F_{5,136}$=19.0, p<0.01) and rank (η^2=0.369, $F_{5,136}$=15.9, p<0.01) have an overall significant effect but their interaction does not (η^2=0.0.14, $F_{5,136}$=0.39, p=NS). This means that the effect of each factor is independent of the effect of the other.
Table 1 shows the mean values and standard deviations of the performance indicators for men's and women's beach volleyball teams from the three Olympics. Univariate analysis revealed that women in comparison to men had significantly greater mean values in SAP, but significantly reduced mean values in ASP and BPG.

Table 1. Mean values and standard deviations of the performance indicators for men's and women's beach volleyball. Comparisons with the independent samples t-test.

Performance indicator	Women	Men	t-value (p-value)
ASP (%)	49.5±5.6	51.9±5.3	-2.66 (0.009)

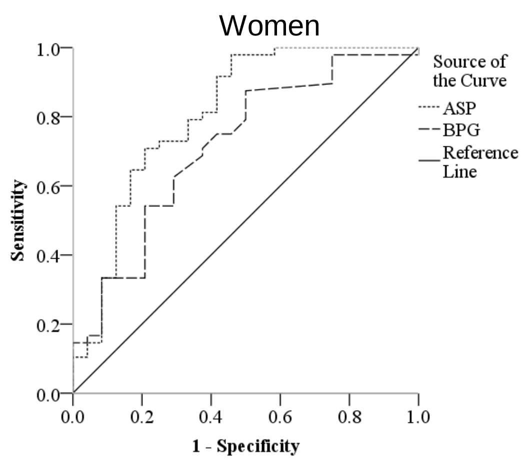
SAP (%)	6.1±2.8	3.4±1.9	6.81 (0.000)
SFP (%)	11.8±4.7	10.5±4.2	1.72 (0.088)
BPG (number)	2.1±1.1	3.3±1.2	-5.93 (0.000)
DPG (number)	14.1±6.2	12.3±5.3	1.89 (0.061)
OEPG (number)	10.5±2.4	10.2±2.0	0.72 (.476)

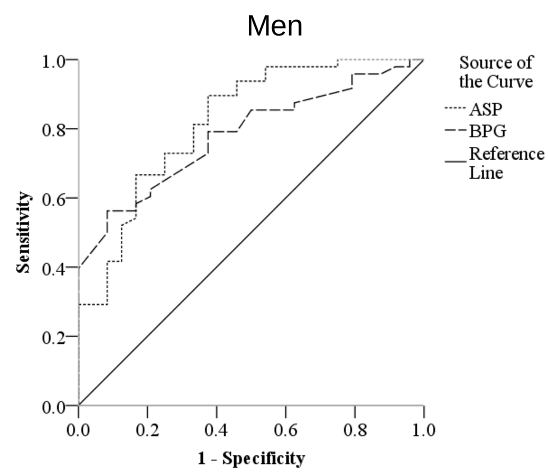
Also, the lower-ranked teams in comparison to top-ranked teams had significantly reduced ASP (46.5%±6.1% vs 52.8%±3.9%, p<0.01) and BPG (2.0±1.0 vs 3.0±1.3, p<0.01) and significantly increased SFP (12.2%±4.1% vs 10.6%±4.6, p<0.05). The variable OEPG had a mean value of 10.4±3.2 and was independent of the tournament, gender and rank.
Table 1 shows that the dependence of the ranking on the performance indicators follows the same pattern for both sexes. In both cases significant predictors of the ranking prove to be ASP and BPG, yielding an R^2 of 0.415 and 0.471 for women and men correspondingly.

Table 2. Results of the linear regression model of the dependence of ranking on the performance indicators.

	Women			**Men**		
Parameter	**Coefficient**	**t-value**	**p-value**	**Coefficient**	**t-value**	**p-value**
Constant	41.2	8.3	<0.01	42.5	8.1	<0.01
ASP	-55.6	-5.4	<0.01	-49.8	-4.6	<0.01
BPG	-1.6	-3.1	<0.01	-1.9	-4.1	<0.01

Similarly ROC analysis proved that the same two performance indicators of ASP and BPG have significant ability of discrimination between low-rank and high-rank teams in both men and women (Figure 1). As expected the determined cutoffs were higher for men than for women (53% versus 50% for ASP and 3.77 versus 2.35 for BPG).





AUC for ASP=0.808 (0.691-0.925)
AUC for BPG=0.714 (0.586-0.843)

AUC for ASP=0.821 (0.716-0.925)
AUC for BPG=0.781 (0.677-0.785)

Best cutoffs: ASP=50%, BPG=2.35 Best cutoffs: ASP=53%, BPG=3.77

Figure 1. ROC analysis of the discrimination ability of ASP and BPG on the RG binary variable.

Subsequent analysis proved that in both men and women and in both performance indicators of ASP and BPG if the team achieved the cutoff value then the probability of being among the high–rank teams is practically doubled (Figure 2). Actually teams that do not attain the cutoff points have a probability of reaching the playoffs ranging from 42.4% to 53.7%. These probabilities are significantly lower than the theoretically expected value o 16/24=66.7%. Conversely attaining at least one cutoff point raises the probability of entering the playoffs from 83.9% to 93.1%. These probabilities are significantly higher than the theoretically expected value of 66.7%

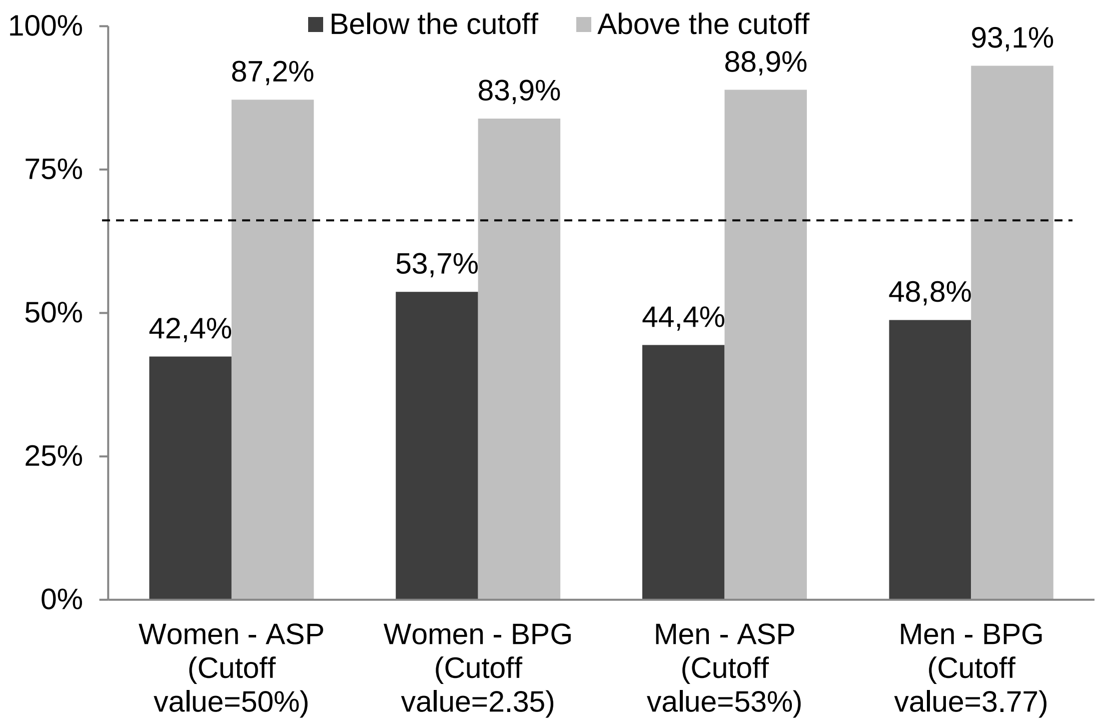


Figure 2. Proportion of high-rank teams based on whether they achieved the cutoff value for ASP and BPG for men and women.

Figure 3 provides more detailed information on the probability of entering the playoffs based on the combination of the two criteria of ASP and BPG. In men, teams that satisfy both criteria (ASP>53% and BPG>3.77) will invariably enter the playoffs, since the probability is 100%. This probability is also very high in women (94.7%). Achieving only one criterion gives the team a slight advantage of entering the high-rank teams, while the absence of both criteria definitely puts the team at a disadvantage, since the probability that it will only play in the preliminary round is 100%- 28.6%=71.4% for women and 100%-35.7%=64.3% for men. These are very high proportions given that only 8/24=33.3% teams are disqualified in the preliminary round.

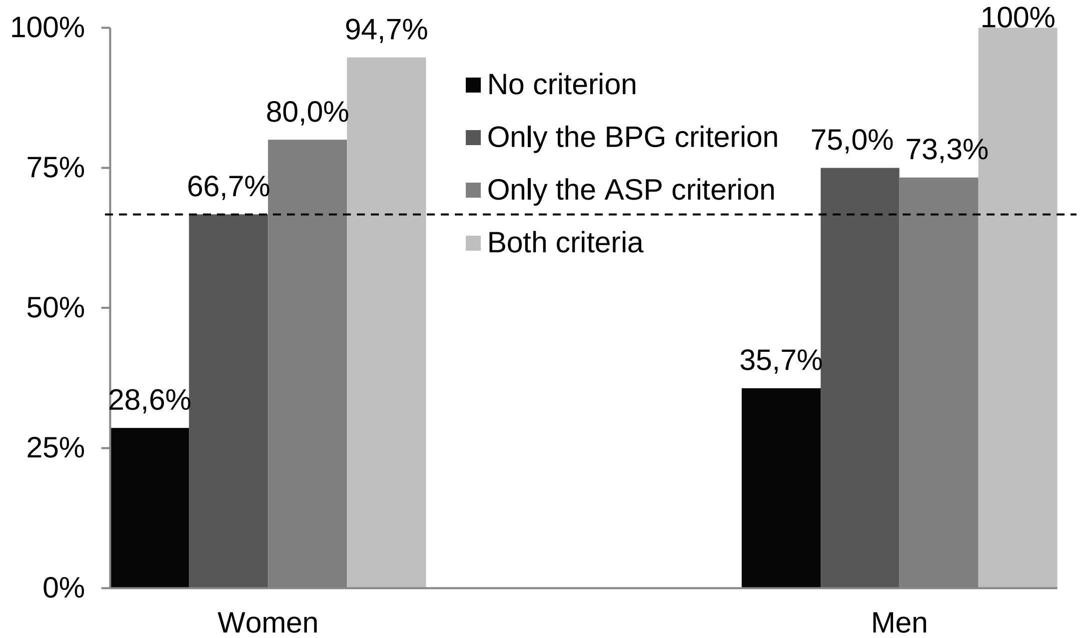


Figure 3. Proportion of high-rank teams based on the combination of the cutoff value for ASP and BPG for men and women.

4 Discussion

Borrowing a term originating from video games the “gameplay” of BV consists of a series of skills, repeated at every rally, most of which are easily quantifiable into very specific performance indicators. The fact that these performance indicators, both for men and women, showed no significant variability between the three Olympics, an eight-year span, signifies that the overall profile of the game of BV in terms of winning or losing a rally has remained relatively stable.

However, in the current study it has been shown that some of these performance indicators prove to be comparatively more consequential than others in determining the outcome of the rally, the set, the game, and the contest. Specifically, it was found that the ranking of a BV team in both men and women in the last three Olympic tournaments (Athens, Beijing and London) was significantly dependent on two performance indicators, namely the proportion of successful attacks and the number of successful blocks. Subsequent analysis of these two skills established the appropriate cutoff values that can be considered as norms that greatly enhance the teams’ chances of entering the playoffs and playing elimination games with other high-rank teams.

It is true that during the game the players will hardly bother to check the statistics. Even more, even today “players are not allowed to receive external assistance or coaching during a match” (FIVB, 2012), even if there exist are a number of software programs, which allow for real-time data entry and evaluation of the data by the coaches, while the game is still playing (Data Volley, 2007). Nevertheless, it is only logical to assume that the winning team is bound to have better statistics in one or more performance indicators.

It is interesting that both the above performance indicators are also gender dependent, consequently these norms differ between men and women. In order to participate in high-level tournaments men should have higher proportions of successful attacks and more successful blocks than women.

It has already been pointed out that "the game of Beach Volley is played quite differently by men and by women" (Laios, 2008), a conclusion later corroborated by Koch and Tilp (2009). Specifically, as Laios concludes, "the evident difference in muscular power between the two genders is the major factor discriminating the game tactics of Beach Volley". Indeed, there is very little to be done against a smash spike performed with more power and from a greater height at the net. Even though the dimensions of the court are less than those in classic Volleyball, each of the two players have to defend on an average an area of 64/2=32m2 instead of 81/6=13.5m2, on a more demanding terrain.

The above considerations fully justify the higher proportion of successful attacks evidenced in men's games. At the same time in men's games the same reasons are "forcing one of the players of the opposing team to make a block defense" (Laios, 2008), while women predominantly choose a back-floor defense.

Despite the differences in the cutoff levels between men and women the patterns that differentiate high-rank from low-rank beach volleyball participating in the Olympic tournaments are the same: a successful team has to be able to force a sufficient proportion of successful attacks and at the same time to efficiently block a sufficient number of the opponent's attacks.

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