

Original article (short paper)

Physical actions and work-rest time in men's beach volleyball

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Abstract—The purpose of this study was to assess the ball contacts, jumps, hits, work time, and rest ratio in male beach volleyball players in relation to their tactical roles. The sample of this study included 6970 rallies played by 91 beach volleyball players, which corresponded to 179 sets of the 2008 Men's Beach Volleyball World Tour (FIVB). We analyzed: ball contacts, jumps, hits, work time, rest time, set (first, second or third), and player's tactical role (e.g., defense specialist, blocker, or no specialization). A significantly higher number of jumps were executed by blockers. No differences were found in the third set for any of the physical variables studied. This paper provides references about the physical demands (e.g., contacts, jumps, and hits for blockers and defense specialists) and temporal patterns of the beach volleyball game (i.e., work and rest time) for two-set matches and three-set matches.

Keywords: performance, temporal patterns, physical patterns

Resumo—“Ações físicas e intervalo trabalho-descanso em voleibol de praia masculino.” O objetivo do presente estudo foi avaliar o número de contatos com a bola, saltos, ataques, tempo de trabalho e descanso em jogadores de voleibol de praia masculino em função da sua especialização. A amostra do estudo foi composta por 6970 rallies, jogados por 91 participantes, correspondendo a 179 sets do Beach Volleyball World Tour (FIVB) de 2008. As variáveis estudadas foram: contatos com a bola, saltos, ataques, tempo de trabalho, tempo de descanso, set (1º, 2º e 3º) e especialização do jogador (defensor especialista, bloqueador, ou não especializado). Um número significativo de saltos foi realizado pelos bloqueadores. Não foram encontradas diferenças significativas no 3º set para qualquer uma das variáveis estudadas. Este estudo apresenta valores de referência acerca das demandas físicas (contatos, saltos e ataques realizados por bloqueadores e defensores especialistas) e dos padrões temporais do jogo de voleibol de praia (tempo de trabalho e descanso) para jogos de dois e três sets.

Palavras-chave: rendimento, padrões temporais, padrões físicos

Resumen—“Acciones físicas y tiempos de trabajo-descanso en voley-playa masculino.” El objetivo de este estudio fue medir el número de contactos con el balón, saltos, golpes, el tiempo de trabajo y de descanso de jugadores de voley-playa masculino en función de su rol de juego. La muestra de estudio estuvo compuesta por 6970 jugadas realizadas por 91 jugadores participantes en 179 sets de la Beach Volleyball World Tour (FIVB) de la temporada 2008. Las variables registradas fueron contactos realizadas, saltos, golpes, tiempo trabajo, tiempo de descanso, set (1º, 2º, o 3º), and función de juego (bloqueador, especialista en defensa, o universal). Un significativo mayor número de saltos fueron realizados por los bloqueadores. No se encontraron diferencias en el tercer en ninguna de las variables físicas estudiadas. Este trabajo presenta valores de referencias de las demandas físicas (balón, saltos, golpes) y parámetros temporales (tiempo de trabajo y de descanso) del juego del voley-playa para partidos de dos sets y de tres sets.

Palabras claves: rendimiento, patrones temporales, patrones físicos

Introduction

The way in which a sport is played depends on the formal structure established by its rules. Beach volleyball is a relatively new sport with origins in indoor volleyball. The two sports have similar rules and structures; however, there are important differences between them (Table 1). In general, the most important differences are the number of players per team, the type of court, and the environment (indoor vs. outdoor).

Compared with indoor volleyball, a low number of specialized publications (i.e. research papers) are found about beach volleyball. In addition to the little objective information about beach volleyball, most beach volleyball coaches and players transitioned from indoor volleyball and their tactical and technical reference values are based on indoor volleyball (Homberg & Papageorgiu, 1994). The lack of reference values, or the use of inadequate ones, makes the training of beach volleyball difficult for players. Based on the review of the literature, studies that investigate the physical aspects of the game found the following reference values: 52-85 jumps per player per match, a jump is performed every 42 seconds, the average rally time lasts 8.5 s, the number of rallies per match ranges from 78 to 96, and match duration ranges from 30 to 64 minutes (Giatsis & Tzetzis, 2006; Giatsis, Zetou, & Tzetzis, 2003; Palao, Valades, & Ortega, 2012; Pérez-Turpin, Cortell, Cejuela, Chinchilla, & Suárez, 2008). However, studies that assess tactical roles of beach volleyball players seem to be nonexistent. In beach volleyball, the following players' tactical roles include: blocker, defense specialist, and no specialization or universal (Homberg & Papageorgiu, 1994). Players' anthropometric and physical capacities are unique and allow them to better carry out their functions in the game. (Palao, Gutiérrez, & Frideres, 2008). Blockers may execute more jumps because they are supposed to block each attack of an opponent. The defense specialist may perform more ball contacts and/or hits because they are in charge of the defense and counter-attack. The information about physical actions and work-rest time is necessary to design adequate and specific training protocols and tasks. Knowledge of reference values can help coaches and strength and conditioning coaches to design their practice and work-outs. Objective information based on evidence-based data is a key aspect for establishing the demands of beach volleyball

in elite teams and for planning training to prepare athletes for matches. The purpose of this study was to assess the ball contacts, jumps, hits, work time, and rest ratios of male beach volleyball players in relation to their tactical roles.

Methods

Sample

A total of 91 beach volleyball players from 48 teams that participated in the 2008 Men's Beach Volleyball World Tour organized by the Fédération Internationale de Volleyball (FIVB) were studied. A total of 179 sets (84 matches) and 6970 rallies were analyzed. The sample included confrontations that occurred between the first 50 teams of the World Tour (FIVB) ranking of the 2007-2008 seasons. Players originated from 23 countries and they had an average height of 1.93 m (\pm 6.0), an average weight of 88.7 kg (\pm 6.3), and an average age of 30.3 years (\pm 5.3). The anthropometric data of these athletes were obtained from the FIVB's website. These players were divided into three groups: blockers, defenders, and universals (no specialization). Among the players, 46.2% were blockers, 47.2% were defenders, and 6.6% were universal players. To establish the representation of the study's sample we, first, determined three levels of teams' ranks (i.e., 1st-15th, 16th-30th, and 31st-50th). An equal number of sets of the six possible combinations of confrontations between these three levels were included. Secondly, we included a maximum of four matches or twelve sets per team. The researchers of this study videotaped the matches aired by the Eurosport and Eurosport 2 channels and, additionally, obtained matches recorded by the Spanish National Coach.

Procedures

Based on Anguera (2003), we conducted an observational study (punctual, nomothetic, and multidimensional) and, to collect the data, we employed a category system. The coded variables were: ball contacts, jumps, hits, work time (duration of the rally), rest time (time between rallies), set (first, second or third), and player role (defense specialist, blocker, and no specialization or universal). The matches were analyzed through systematic observation (Anguera, 2003) by four experienced and trained observers. Inter- and intra-reliability of two separate observations were calculated to guarantee sufficient quality of the observation system. An inter-reliability index of .87 and an intra-reliability index of .98 were found (intraclass correlation coefficient for the continuous variables and Kappa index for the nominal variables).

Statistical analysis

Due to the different number of points needed to complete the game set, the data from the third set (15-point set) was separately analyzed from the data of the first two sets of the matches (21-point sets). A Kolmogorov-Smirnov and *Chi-S-*

Table 1. Differences between indoor volleyball and beach volleyball.

Indoor volleyball	Beach volleyball
Indoor (stable conditions).	Outdoor (unstable; players and ball are affected by wind, sun, temperature, etc.).
Six starters and six reserves per team.	Two players per team (no reserves).
9 x 9 m (total of 81 m ² ; 13 m ² per player).	8 x 8 m (total of 64 m ² ; 32 m ² per player).
Ball handling (three contacts per team; block does not count as team contact; limitation on pushing ball in attack; and no retention allowed in dig).	Ball handling (three contacts per team; no rotation of the ball allowed in the set; limitations include no retention in reception or dig).

quare test were used to test the normal distribution and the homogeneity of the data. All variables followed the normality principles and, therefore, included in a parametric statistics procedures. A one-factor analysis of variance between the various specific positions was used with the Scheffe *post-hoc* test to analyze the differences in the studied variables. The Scheffe *post-hoc* test was selected because the sample was greater than 50 cases. All of the statistical analyses used level of significance of $p \leq .05$. All statistical analyses were conducted using the SPSS statistical package (version 18.00, Institute Inc., Cary, NC, USA).

Results

With regard the contacts, jumps, and hits per play (Table 2), we found no significant differences between players of different tactical roles in relation to the average contacts per set (50-52, ± 17 -19 ball contacts per set). Blockers performed a significantly higher number of jumps per set than defense specialists ($p < .001$) and universal players ($p < .001$). Blockers averaged 32.8 jumps per set (± 12.4), defense specialists averaged 27.7 jumps (± 11.7), and universal players averaged 26.8 jumps per set

(± 8.6). We found no significant differences between players' tactical roles in the number of hits executed by set (21-22, ± 9 -10 hits per set).

In relation to work time and rest time (Table 3), we found an average of 7.25 s (± 6.12) of work time. The duration (play time) of a rally was between 3 and 12 s (90% of the actions). The rest time per play lasted in average 19.71 s (± 10.33). The rest duration between rallies was between 2 and 31 s (90% of the actions). The average work-rest ratio was 1:4.42 (± 5.73). The average number of rallies per match was 38.0 (± 4.7).

The number of rallies, work time, rest time, contacts, number of hits, and number of jumps, all showed differences between sets 1 and 2 compared to set 3 (Table 4). The data for set 3 exhibited lower values for all these variables. In the third set (15-point set), the values for contacts, jumps, and hits were lower than the previous sets. Defense specialists performed 35 (± 10.6) contacts, 19.6 (± 6.5) jumps, and 14.8 (± 6.2) hits. Blockers performed 34.9 (± 9.3) contacts, 21.3 (± 4.3) jumps, and 15.1 (± 5.0) hits. Universal players performed 34.6 (± 12.3) contacts, 19.3 (± 5.7) jumps, and 14.3 (± 8.3) hits. We found no significant differences in these actions between players' tactical roles in the third set.

Table 2. Contacts, jumps, and hits per rally and set by player tactical role in men's beach volleyball.

	Rally (n=6970)			Set (n=179)		
	Average	SD	Ratio	Average	SD	Percentile (10 th -90 th)
Contacts						
Defense specialist	1.29*	1.04	1: 5.28	49.79	19.52	30 - 72
Blocker	1.25	1.01	1: 5.47	48.26	17.39	30 - 69
No specialization	1.27	1.00	1: 5.28	47.04	14.74	28 -66
Jumps						
Defense specialist	0.69	0.73	1: 7.05	26.6	11.7	14 - 41
Blocker	0.81***	0.80	1: 6.62*	31.2***	12.2	18 - 48
No specialization	0.68	0.69	1: 6.78	25.3	8.5	12 - 38
Hits						
Defense specialist	0.53	0.58	1: 7.51	20.7	10.0	10 - 33
Blocker	0.54	0.58	1: 7.40	21.0	9.3	10 - 33
No specialization	0.53	0.56	1: 7.31	19.6	9.1	7 - 35

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3. Work time, rest time, and rallies per play and set in men's beach volleyball.

	Rally (n=6970)			Set (n=179)		
	M	SD	Percentile (10 th -90 th)	M	SD	Percentile (10 th -90 th)
Work time (s)	7.26	6.14	2 - 12	266.9	84.2	177 - 368
Rest time (s)	20.08	11.34	3 - 31	720.1	216.0	531 - 1041
Ratio work-rest	1:4.57	5.8	0.5 - 8	1:2.8	0.8	1: 2-4
Rallies	-	-	-	37.9	4.9	-

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4. Differences between sets in work time, rest time, ratio work-rest, contacts, hits, and jumps in men's beach volleyball.

	Set 1		Set 2		Set 3	
	M	SD	M	SD	M	SD
Rallies	37.71	5.42	38.25	4.12	28.3***	4.29
Work Time (s)	269.60	100.63	263.56	59.30	193.77*	42.36
Rest Time	719.33	231.20	721.00	199.15	503.46**	70.45
Ratio Work-rest	1:2.87	0.92	1:2.81	0.77	1:2.69	.56
Contacts	270.53	103.29	245.11	35.86	177.4**	27.83
Hits	132.14	43.87	125.20	15.71	89.8***	12.03
Jumps	178.50	61.37	168.30	24.12	119.7***	17.36

* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

The purpose of this study was to establish the physical and temporal characteristics of the men's beach volleyball performance in relation to players' tactical roles. Regarding physical aspects, the results show significant differences in jumps, but not in ball contacts or hits. Blockers executed a higher number of jumps per set than defense specialists. This is because the defense phase blockers are responsible for the blocking. The lack of differences in the other actions indicates that beach volleyball players are likely trained in similar way when physical aspects are taken into consideration. The fact that both players' tactical roles have similar functions in the attack phase means that beach volleyball requires more generic and less specialization by tactical role). Previous studies shown data about the number of jumps without making distinction between players' tactical role, nor considered the number of sets per match. Differentiation of players' tactical roles and organization of the data by match sets provide us with more detailed information about actual intensity exerted by the players in each game, and can guide training protocols with respect to the players' physical needs.

When data from the third set was separately taken into consideration, no differences were found regarding the contacts, jumps, or hits executed by players of different tactical roles. The data found illustrate the effects of emotional characteristics of players when performing the last set (Marcelino *et al.*, 2009). Additionally, the different number of required points (21-point set vs. 15-point set) to close the set makes this match situation unique. The reason for not finding differences between blockers and defenders could be due to changes in the game's strategy and players' tiredness. Another possibility is that blockers that have to jump to block in all opponent side-outs may decide to use the standing serve more often in the third set, therefore reducing the number of jumps. Also, it is possible that the opponent team decides to serve more often to the defender in the third set, therefore overloading this player and taking advantage of the tired defender. The descriptive differences between the standard deviation between the first set and the second and third sets show that the first set is more variable and unpredictable than

the others. The reason for this could be related to fatigue, as the variability is lower when the match advances. The results show that the use of the rally and the set as units of analysis and the differentiation of the type of set (first or second set vs third set) allow the coaches to establish and calculate the range of actions performed by players in matches of two sets and in matches of three sets.

With regard to the temporal aspects, the average work time found was similar to the one found in previous studies (one second lower). The present study provides information about the rest time and the work-rest ratio. This information could be useful to strength and conditioning coaches and sport coaches as reference values to plan their tasks and physical training. The values for work time are similar to those of indoor volleyball (Vescovi, 2002). However, the rest and work-rest ratio is higher in beach volleyball than in indoor volleyball (1:4 vs. 1:2). The intensity of the actions players have to undergo during the work time on sand and on hard-floor surfaces is probably the reason why the rest time and work/rest ratio are higher (1:4) for beach volleyball. The reason for this difference may be because player takes advantage of the options to interrupt play more often and intentionally increases the rest time in order to recover. Nevertheless, the variation found in the duration of the work and rest time in sample studies is important. Work time varies from 3 to 12 s, and rest time varies from 2 to 31 s. This information is important to properly design the physical training demands for beach volleyball players.

This study presents information related to physical and temporal aspects of men's beach volleyball, which could be used as reference values for sport professionals. Information such as the number of rallies per set (with an average of 38) can be used by sport coaches and strength coaches to design their training and exercise programs. The data show that work and rest time in practice should not always be standard. The range of variation of the players' actions should be taken into consideration in order to create task-like game situations in practice. These results show differences in temporal patterns between indoor volleyball and beach volleyball, and confirm that their formal structure is different. Therefore, indoor and beach volleyball players should be trained differently. Some criteria from indoor volleyball can be adapted to beach volleyball; however, the games are different.

Conclusion

The tactical roles of volleyball players determine their physical activity profiles in beach volleyball. These differences must be considered in order to practice and train athletes properly to meet the needs and demands of the game. Our data show that beach volleyball has different physical demands and temporal patterns than indoor volleyball. The present study provides data that can be used as reference values for coaches, strength and conditioning coaches, and researchers to plan their practices and understand the game. Future studies are needed in this area to provide reference values according to age category, sex, game style, etc.

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